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A STUDY OF THE CONCURRENT VALIDITY OF THE MINNESOTA TESTS OF CREATIVE THINKING, ABBR. FORM VII, FOR EIGHTH GRADE INDUSTRIAL ARTS STUDENTS.

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DESCRIPTORS- *INDUSTRIAL ARTS, GRADE 8, *CREATIVITY, *CREATIVITY RESEARCH, MALES, *TEST VALIDITY, STUDENT EVALUATION, TESTS, MINNESOTA TESTS OF CREATIVE THINKING,

THE PRIMARY OBJECTIVE OF THIS STUDY WAS TO ESTABLISH THE CONCURRENT VALIDITY OF THE MINNESOTA TESTS OF CREATIVE THINKING, ABBREVIATED FORM VII, (MTCT VII) BY DETERMINING THE RELATIONSHIP BETWEEN ITS SCORES AND CREATIVE ABILITY AS MEASURED BY ACCUMULATED TEACHER RATINGS OF INDUSTRIAL ARTS PROJECTS AND INVESTIGATOR-DEVELOPED TESTS OF CREATIVITY. THE SAMPLE INCLUDED 129 EIGHTH GRADE MALE INDUSTRIAL ARTS STUDENTS. THE PERSON PRODUCT MOVEMENT CORRELATION COEFFICIENT WAS USED TO ESTIMATE THE CONCURRENT VALIDITY OF THE MTCT VII AND TO ASCERTAIN THE RELATIONSHIP BETWEEN ACCUMULATED TEACHER RATINGS AND THE INVESTIGATOR'S TESTS. MULTIPLE REGRESSION EQUATIONS WERE DEVELOPED TO ASCERTAIN WHICH COMBINATIONS OF THE VARIABLE IN THE MTCT VII WOULD BEST PREDICT EACH OF THE VARIABLES IN THE INVESTIGATOR'S TEST. SOME CONCLUSIONS WERE--(1) A FACILITY FOR SUPPLYING DETAIL AND SUPPORTING IDEAS ON A PAPER AND PENCIL TEST MAY BE SLIGHTLY INDICATIVE OF CREATIVE BEHAVIOR, (2) THE FACILITY TO GENERATE UNUSUAL IDEAS MAY BE ACCOMPANIED BY THE ABILITY TO PRODUCE USEFUL PRODUCTS, (3) THE JUNIOR HIGH STUDENTS WITH UNUSUAL AND USEFUL IDEAS OF A FIGURAL NATURE TEND TO POSSESS MORE DESIRABLE TRAITS OF PERSONALITY THAN LESS CREATIVE PEERS, (4) BEHAVIORAL CREATIVITY TENDS TO HAVE LITTLE RELATIONSHIP, AND SYMBOLIC CREATIVITY NO RELATIONSHIP, TO MEASURES OF STANDARDIZED ACHIEVEMENT, AND (5) BOTH VERBAL AND NONVERBAL INTELLIGENCE MEASURES APPEARED TO HAVE A SIGNIFICANT BUT LOW RELATIONSHIP TO SPECIALIZED PERFORMANCE TEST MEASURES OF FIGURAL AND BEHAVIORAL CREATIVITY, BUT INSIGIFICANT RELATIONSHIPS WITH MEASURES OF SYMBOLIC CREATIVITY. FINDINGS SUGGEST THAT TNE MTCT VII MAY BE MEASURING OTHER FACTORS THAN ARE REQUIRED BY STUDENTS IN THE CREATIVE PERFORMANCE OF INDUSTRIAL ARTS RELATED TASKS. (EM)

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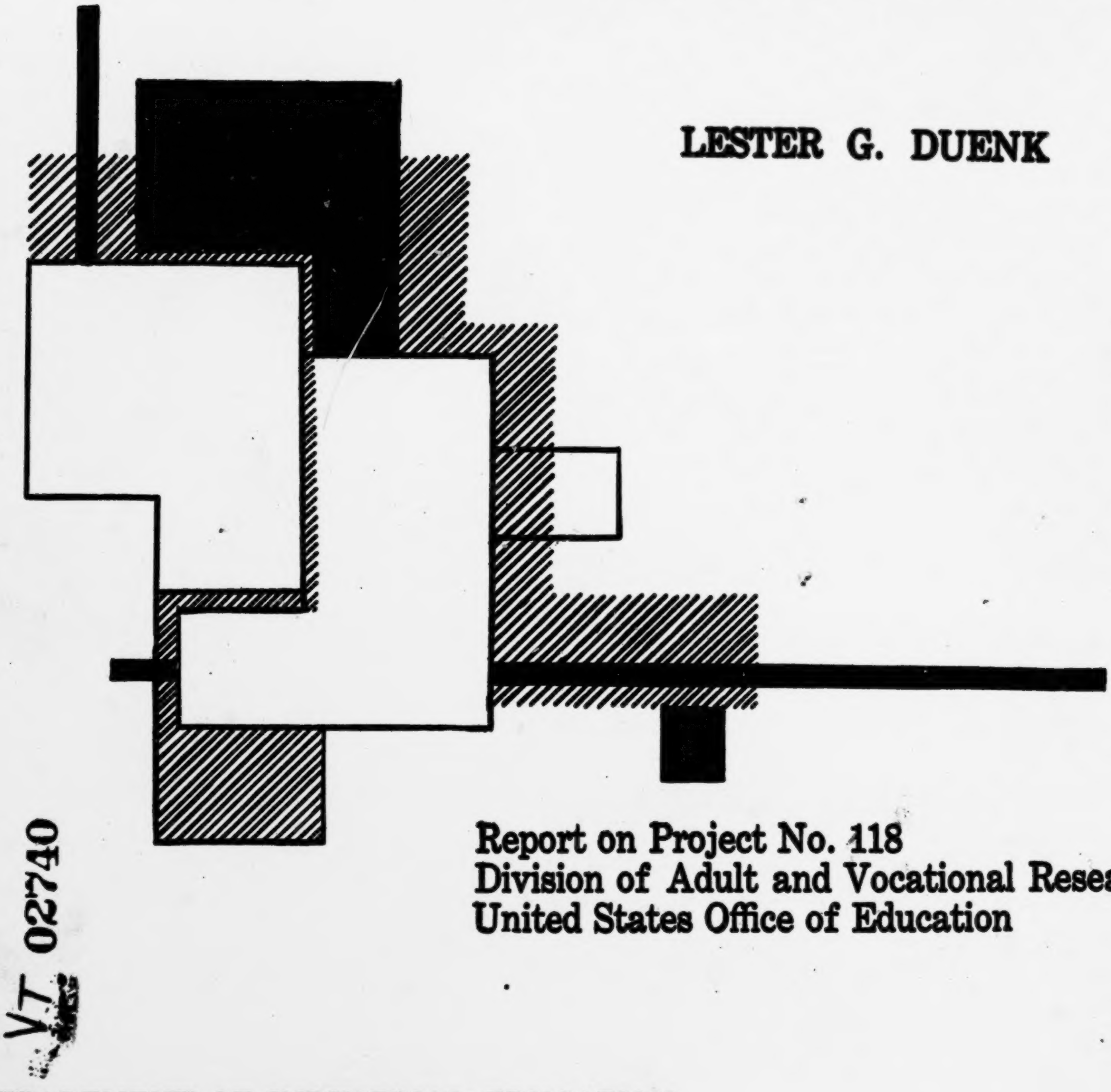

LESTER G. DUENK

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DEPARTMENT OF INDUSTRIAL EDUCATION
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Lester G. Duenk
Principal Investigator
April, 1966

TABLE OF CONTENTS

Page

ACKNOWLEDGEMENTS ii

LIST OF TABLES v

Chapter

I. INTRODUCTION TO THE PROBLEM 1

A Growing Concern For the Development of Creativity 1

Current Emphasis on Creative Thinking 2

Statement of the Problem 4

Hypotheses 7

Definition of Terms 8

Overview of the Study 10

II. RELATED LITERATURE 14

Some Approaches to the Measurement of Creativity .. 14

Concurrent Validity and Reliability of the Minnesota Tests of Creative Thinking 21

Relationships Among Achievement, Intelligence and Creativity 26

Relationships Among Traits of Personality and Creativity 36

III. DESIGN OF INSTRUMENTS AND COLLECTION OF DATA 50

Definition of Creativity in Industrial Arts 50

Population-sample 51

Development of Instruments for Approach B 52

Measurement of Symbolic Unusualness and Usefulness, Approach B 54

Measurement of Figural Unusualness and Usefulness, Approach B 73

Measurement of Behavioral Unusualness and Usefulness, Approach B 87

Combining Unusualness and Usefulness Scores, Approach B 112

Collection of Other Data 114

Chapter Page

Other Measures of Creativity 116

Socio-economic, Aptitude, Achievement and Personality Measures 122

IV. FINDINGS: RELATIONSHIPS AMONG MEASURES OF CREATIVITY 126

A Comparison of Test Approaches 126

Relationships Between Measures Within Approaches .. 139

V. FINDINGS: RELATIONSHIPS AMONG CREATIVITY, INTELLIGENCE, ACHIEVEMENT, AND PERSONALITY RATINGS 153

Relationships Between IQ and Various Measures of Creative Ability 153

Relationships Between School Achievement and Various Measures of Creative Ability 158

Relationships Between Personality Ratings and Various Measures of Creative Ability 168

VI. SUMMARY, CONCLUSIONS AND IMPLICATIONS 175

Summary 175

Conclusions 177

Implications 181

VII. SELECTED BIBLIOGRAPHY 185

APPENDICES 191

A. Personality Grading Scale 192

B. What is Creativity in Industrial Arts? 195

C. Special Tools for Shaping Styrofoam, Test Approach B 201

D. Instrument for Evaluating Behavioral Creativity, Test Approach B 203

E. The Minnesota Tests of Creative Thinking, Abbr. Form VII 207

LIST OF TABLES

Table Page

1. Symbolic Unusualness, Frequency of Occurrence, Category No. 1: Plane View, Basic Shape 60

2. Symbolic Unusualness, Frequency of Occurrence, Category No. 2: Side Contour of Product 61

3. Symbolic Unusualness, Frequency of Occurrence, Category No. 3: Thickness of Lip (Plane View) 62

4. Symbolic Unusualness, Frequency of Occurrence, Category No. 4: Support 63

5. Symbolic Unusualness, Frequency of Occurrence, Category No. 5: Ornamentation 65

6. Symbolic Unusualness, Frequency of Occurrence, Category No. 6: Lifting Devices, Covers 66

7. Symbolic Unusualness, Frequency of Occurrence, Category No. 7: Relationship of Inside to Outside Contour 67

8. Symbolic Unusualness, Frequency of Occurrence, Category No. 8: Divisions, Trays, Units 68

9. Computation of Total Symbolic Unusualness Scores For Products R1 to R10 70

10. Percentage of the Total Group, Number of Products and Codes Assigned to Each of Seven Categories 71

11. Computation of Total Symbolic Usefulness Scores for Products R1 to R10 74

12. Figural Unusualness, Frequency of Occurrence, Category No. 1: Function in Use (wrench) 77

13. Figural Unusualness, Frequency of Occurrence, Category No. 2: Function in Use (opener) 77

14. Figural Unusualness, Frequency of Occurrence, Category No. 3: Pieces in Total Construction 78

15. Figural Unusualness, Frequency of Occurrence, Category No. 4: Folding or Swivel Action 78

16. Figural Unusualness, Frequency of Occurrence, Category No. 5: Reinforcement 79

Table Page

17. Figural Unusualness, Frequency of Occurrence, Category No. 6: Handle Shape 79

18. Figural Unusualness, Frequency of Occurrence, Category No. 7: Accessibility 80

19. Figural Unusualness, Frequency of Occurrence, Category No. 8: Removable Parts 80

20. Figural Unusualness, Frequency of Occurrence, Category No. 9: Leverage 81

21. Figural Unusualness, Frequency of Occurrence, Category No. 10: Offset (to provide clearance) 81

22. Figural Unusualness, Frequency of Occurrence, Category No. 11: Storage 82

23. Figural Unusualness, Frequency of Occurrence, Category No. 12: Hand Protection 82

24. Figural Unusualness, Frequency of Occurrence, Category No. 13: Manner of Joining Parts 83

25. Figural Unusualness, Frequency of Occurrence, Category No. 14: Other Features 83

26. Computation of Total Figural Unusualness Scores for Products R1 to R10 85

27. Computation of Total Figural Usefulness Scores for Products R1 to R10 86

28. Behavioral Unusualness, Frequency of Occurrence, Problem No. 1 89

29. Behavioral Unusualness, Frequency of Occurrence, Problem No. 2 93

30. Behavioral Unusualness, Frequency of Occurrence, Problem No. 3 97

31. Behavioral Unusualness, Frequency of Occurrence, Problem No. 4 100

32. Behavioral Unusualness, Frequency of Occurrence, Problem No. 5 103

33. Behavioral Unusualness, Frequency of Occurrence, Problem No. 6 106

Table Page

34. Computation of Total Behavioral Unusualness Scores for Products R1 to R10 110

35. Computation of Total Behavioral Usefulness Scores for Subjects R1 to R10 113

36. Computation of Total Behavioral Creativity Scores for Subjects R1 to R10 115

37. Verbal, Non-verbal Classification of Creative Thinking Tasks of the Minnesota Tests of Creative Thinking, Abbr. Form VII 119

38. Comparison of Percents of Parental Employment Between Groups in the Sample and Civilian Employment in Minnesota and the United States by Major Occupational Category 123

39. Means and Standard Deviations of Scores for All Measures of Creativity from Approaches B and C For the Total Sample 127

40. Correlation Coefficients Between MTCT Measures and Specialized Performance Test Measures of Creativity for the Total Sample 129

41. Means and Standard Deviations of Scores for All Measures of Creativity from Approaches A, B, C, and Post-facto Teacher Ratings for Groups I and II 131

42. Correlation Coefficients Between Classroom Performance Measures and Specialized Performance Test Measures of Creativity for Groups I and II 133

43. Correlation Coefficients Between MTCT, Abbr. Form VII Measures and Classroom Performance Measures of Creativity for Groups I and II 136

44. Correlation Coefficients Between Measures Yielded by Approaches A, B, and C, and Post-facto Teacher Ratings of Creativity for Groups I and II 138

45. Intercorrelations Between Specialized Performance Test Measures of Creativity 139

46. Intercorrelations Between MTCT, Abbr. Form VII Measures of Creativity 140

47. Intercorrelations Between Classroom Performance Measures of Creativity for Groups I and II 142

Table Page

48. Multiple Correlation Coefficients and Ordinary and Normal Partial Regression Coefficients of MTCT, Abbr. Form VII Scores Predicting Specialized Performance Test Measures of Creativity (N=129) 144

49. Multiple Correlation Coefficients and Ordinary and Normal Partial Regression Coefficients of Verbal and Non-verbal MTCT, Abbr. Form VII Scores Predicting Specialized Performance Test Measures of Creativity (N=129) 145

50. Multiple Correlation Coefficients and Ordinary and Normal Partial Regression Coefficients of MTCT, Abbr. Form VII Scores Predicting Classroom Performance Measures of Creativity (Groups I and II) 147

51. Multiple Correlation Coefficients and Ordinary and Normal Partial Regression Coefficients of Verbal and Non-verbal MTCT, Abbr. Form VII Scores Predicting Classroom Performance Measures of Creativity (Groups I and II) 148

52. Multiple Correlation Coefficients and Ordinary and Normal Partial Regression Coefficients of MTCT, Abbr. Form VII Scores Predicting Specialized Performance Measures of Creativity (Groups I and II) 149

53. Multiple Correlation Coefficients and Ordinary and Normal Partial Regression Coefficients of Verbal and Non-verbal MTCT, Abbr. Form VII Scores Predicting Specialized Performance Test Measures of Creativity (Groups I and II) 151

54. Means and Standard Deviations of Verbal and Non-verbal IQ for the Total Sample, Groups I and II 154

55. Correlation Coefficients Between Two Measures of IQ and Approach B and C Measures of Creativity 155

56. Correlation Coefficients Between Two Measures of IQ and Approach A, C Measures and Post-facto Teacher Ratings of Creativity 157

57. Means, Standard Deviations and Some Percentiles of the Means of School Achievement Measures 159

58. Correlation Coefficients Between Verbal and Non-verbal IQ and Various Measures of School Achievement 161

Table Page

59. Correlation Coefficients Between Standardized Achievement Test Scores and Approach B and C Measures of Creativity for Total Sample 162

60. Correlation Coefficients Between Standardized Achievement Test Measures and Approach A, C Measures and Post-facto Teacher Ratings of Creativity for Groups I and II 164

61. Correlation Coefficients Between Teacher's Grades and Approach B and C Measures of Creativity for Total Sample 165

62. Correlation Coefficients Between Teacher's Grades and Approach A, C Measures and Post-facto Teacher Ratings of Creativity for Groups I and II 167

63. Means and Standard Deviations of Personality Measures for the Total Sample, Groups I and II 168

64. Correlation Coefficients Between Measures of Personality and Measures of Achievement and IQ for the Total Sample 169

65. Correlation Coefficients Between Approach B and C Measures of Creativity and Teacher Ratings of Student Personality for the Total Sample 171

66. Correlation Coefficients Between Four Measures of Creativity and Teacher Ratings of Student Personality for Groups I and II 173

CHAPTER I

INTRODUCTION TO THE PROBLEM

A Growing Concern for the Development of Creativity

A concern for the development of the unique capabilities of every child is hardly a recent concept in education, nor are efforts at defining and evaluating the creative abilities of students. Early attempts at measuring the creative thinking abilities took place even before the turn of the century and sporadic attempts at developing evaluative instruments for identifying the creatively talented were again undertaken in the second and third decades of this century. Findings of several of the early investigators suggested that those new instruments which sought to measure "creative thinking" abilities were tapping different aspects of mental performance than were being evaluated by the traditional intelligence tests. Such early efforts, however, were considered by many investigators as having novelty value only, and very little sustained research or integrated activity was undertaken during that period.

It was not until 1950, when Guilford at the University of Southern California developed a workable theoretical framework for creativity, that there was a renewed effort made toward achieving a better understanding of creativity assessment. Since that time several of Guilford's original concepts have been adapted and reworked by other investigators, and research has assumed a more systematized, integrated character. This new, organized approach to the study of creative thinking has given direction for the establishment of educational programs designed to promote and develop creative abilities among students. In the past several years, leaders in education, society and industry have become increasingly aware of the desirability of reducing some of the emphasis on the development of convergent intellectual abilities, and a new trend has been observed in which the fostering and growth of divergent problem solving abilities has assumed a heightened importance.

Current Emphasis on Creative Thinking

The late President Kennedy in his address on October 22, 1963 to the National Academy of Sciences spoke of the potential values of creativity:

> "As we begin to master the potentialities of modern science, we move toward a new era in which science can fulfill its creative promise and help bring into existence the happiest society the world has ever known."[1]

Unfortunately, the realization of a happy, free society has been frustrated by, among other things, a paucity of capable problem solvers. Despite the prosperity of this nation, there is hardly a phase of national life which does not cry for improvement, and most often the key is more and better creative thinking. In the sciences we have adequate numbers of technicians and engineers, but those who are able to formulate new hypotheses are few and far between. In industry, a relatively small number of designers, supervisors and researchers contribute virtually all of the innovations which are forthcoming.

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[1] Quoted in C. W. Taylor, (Ed.) Widening Horizons in Creativity (New York, N. Y.: John Wiley and Sons, Inc., 1964), 9.

Not only are our technical problems becoming increasingly complex, but many social problems await creative solutions as well. Consider for example problems of juvenile delinquency, integration, honesty (or its lack) in government and the changing role of productive work. Although we are accustomed to looking to our colleges and universities to supply ingeneous and resourceful leaders, the solutions to these problems are of concern to all persons and therefore to education at all levels. Of special significance is evidence which we have accumulated suggesting that emphasis on the development of creative abilities in the earlier school grades may, in the final analysis, prove to be the most productive approach.[2]

Although it has long been recognized that creative thinking is an invaluable aid in scientific discovery, invention and the arts, there is now evidence which indicates the possible value of utilizing test measures of creative thinking in the prediction of general occupational success. Wallace, by comparing the sales performance of department store salespeople with their scores on the Minnesota Tests of Creative Thinking reported that creative thinking abilities are highly related to sales productivity.[3] Furthermore he found "that salespeople in departments which provide a large amount of customer service are significantly more creative than those in departments where customers require relatively little help in making their purchases."

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[2] M. E. Wilt, Creativity in the Elementary School, (New York, N. Y.: Appleton-Century-Crofts, Inc., 1959).

[3] H. R. Wallace, "Creative Thinking, A Factor in Sales Productivity," Vocational Guidance Quarterly, 9 (Summer, 1961), 223-226.

The possibility is suggested that employees tend to gravitate by chance toward the most satisfying jobs. A prior evaluation of each worker's potential might serve to achieve a satisfactory job adjustment more efficiently. The realization that some positions require higher levels of creative ability than do others, also suggests that jobs be analyzed in terms of creative attributes essential for satisfactory performance.

The development of creative problem solving abilities is a recognized objective of contemporary industrial arts programs. The project method of teaching in industrial arts lends itself to the application of such abilities in the design and construction of useful and attractive articles, both in handicraft and industrial process types of activities. Although the industrial arts teacher is present to impart instruction and information, problem solutions are so varied and numerous that a creative approach on the part of the student is a natural outgrowth of the project method.

Statement of the Problem

The past decade has seen an upsurge of research in the area of creative thinking; a sizable amount of work has been concerned with the development of "creative abilities" and their relationship to measures of academic aptitude and achievement. It has been evidenced in the literature that industrial educators have become increasingly aware of the opportunities afforded for the development of creative thinking abilities in industrial arts laboratory environments.[4] Recent research has supported the feasibility of utilizing specific teaching methods in order to increase creative production among students.[5] Such research in the area of industrial arts has, however, been seriously hampered by a lack of instruments needed to accurately measure such "creative abilities" in industrial arts environments.

Although teacher ratings have been used quite extensively to gather data concerning student creativity, the literature indicates that such measures may indeed be biased unless teacher-raters receive extensive prior training and measures are gathered over extended periods of time. Specialized performance tests have proven to be quite impractical because (1) such tests generally require considerable administration time, and (2) objectiveness in scoring has proven to be a problem. The "creative persons approach" in which eminent creative individuals are studied in order to ascertain the manner in which they differ from their less creative peers is, of course, an impractical method to gain measures of creativity among school age youth.

Most educational researchers have utilized paper and pencil tests in their investigations of the creative abilities of students. The preference for such a test approach is understandable inasmuch as (1) such tests may be standardized on large populations, (2) securing acceptable reliabilities has not posed a problem,

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[4] R. P. Balin, "Encourage Creativity," Industrial Arts and Vocational Education, 49 (November, 1960), 20-21.

[5] W. S. Sommers, "The Influence of Selected Teaching Methods on the Development of Creative Thinking," (Unpublished Ph.D. Thesis, University of Minnesota, 1961).

(3) administration is relatively simple, and (4) scoring systems are objective. However, virtually all paper and pencil instruments which are currently employed for measuring creative abilities are academically oriented, and the degree to which these instruments actually measure "creativity" as it is expressed in the industrial arts laboratory has never been ascertained. Furthermore, the few investigations of the concurrent validity of such tests in other environments suggest that (1) the utility of paper and pencil tests may be restricted due to the lack of any striking evidence which supports their validity, and (2) use of samples from differing populations may produce fluctuations in reported validities.

The Minnesota Tests of Creative Thinking are relatively content-free paper and pencil tests which are appropriate for a wide age range of students. Hence, the value of these tests for the measurement of creative thinking among students in industrial arts environments could prove to be of great value if their concurrent validity can be demonstrated.

The primary objective of this study was to establish the concurrent validity of the Minnesota Tests of Creative Thinking, Abbr. Form VII, by determining the relationships between its scores and criterion measures based upon industrial arts oriented creative performance tests developed by the investigator. A secondary objective was to determine the relationships between measures of creative abilities based upon accumulated teacher ratings of observed student behaviors as they occurred in typical industrial arts classes[6] and those acquired through the use of the investigator's instruments.

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[6] J. Moss, Jr., "Measuring Creative Abilities in Junior High School Industrial Arts," Unpublished Staff Study, (Minneapolis, Minn.: Department of Industrial Education, University of Minnesota, 1965).

Other concomitant purposes of this study were to estimate the relationships among measures of creative abilities in industrial arts as determined by (1) teacher ratings of typical performance in industrial arts, (2) the investigator's specialized performance test approach, (3) the Minnesota Tests of Creative Thinking, Abbr. Form VII, and

a. standardized measures of intelligence.
b. the teacher's perception of certain selected student personality characteristics.
c. school achievement based upon teacher grades.
d. scores from certain standardized achievement tests.

In addition to the foregoing, equations were developed to determine how well a best weighted combination of variables from the Minnesota Tests of Creative Thinking, Abbr. Form VII predicted criterion measures.

Hypotheses

For purposes of simplification, the three approaches to the measurement of creative abilities used in this study are referred to in the following manner:

Approach A. Accumulated teacher ratings of student products as they occurred in typical industrial arts classroom laboratory activities.

Approach B. Specialized tests of industrial arts creativity developed by the investigator.

Approach C. The Minnesota Tests of Creative Thinking, Abbr. Form VII.

The major groups of hypotheses tested were as follows:

H_1 There are no significant relationships between sets of measures of creative abilities as obtained by specialized performance tests (Approach B) and the MTCT, Abbr. Form VII (Approach C).

H_2 There are no significant relationships between sets of measures of creative abilities as obtained by teacher ratings of observed behavior in the classroom (Approach A) and specialized performance tests (Approach B).

H_3 There are no significant relationships among sets of creative abilities involved in behavioral, symbolic and figural content, as measured by specialized performance tests (Approach B).

H_4 There are no significant relationships between sets of creative abilities as measured by Approaches A, B, and C and teacher ratings of selected student personality characteristics.

H_5 There are no significant relationships between sets of creative abilities as measured by Approach B and selected standardized achievement test scores.

H_6 There are no significant relationships between sets of creative abilities as measured by Approach B and teacher grades in selected subjects.

H_7 There are no significant relationships between sets of creative abilities as measured by Approach B and intelligence as measured by a standardized test.

H_8 Combinations of measures yielded by the MTCT, Abbr. Form VII (Approach C) are not significant predictors of criterion measures yielded by specialized performance test scores (Approach B).

Definition of Terms

Several terms which were used consistently throughout the study are defined below.[7]

1. Unusualness. The probability of occurrence based upon actual or expected frequency of similar responses from students in the same class, to the same stimulus. The less frequently a particular response (behavior) is evidenced, the more unusual it is.

2. Usefulness. The degree to which a response (behavior) satisfies the requirement of the problem situation (stimulus) which incited it.

---

[7] For a discussion and further clarification of these terms see What is Creativity in Industrial Arts, Appendix B.

3. Creative thinking. The term "creative thinking", as used in this study, is expressed in the following definition of creative thinking in industrial arts developed by Moss and Bjorkquist.

> When a student organizes his past experience in such a manner as to reach an unusual and useful solution to a perceived problem, he has formulated a creative idea. When the idea is expressed in an observable, overt form, he has developed a creative product. A student's creative ability is evidenced by (a) the relative degree of unusualness and usefulness of each of his products, and (b) the total number of his creative products.[8]

(See Appendix B for a further elaboration of this definition)

4. Symbolic creativity. Creative behavior in which the ideational content deals with the aesthetic and other abstract qualities of tangible objects or processes. In industrial arts, symbolic creativity might be represented in types of coding or representations, systems of measurement or the artistic aspects of design.

5. Figural creativity. Creative behavior in which the ideational content deals with the manipulation of real, concrete inanimate objects and processes. Typically such creative behaviors might be expressed in the combination or use of materials for functional purposes, the sequence or kind of operations used in completing a project, or the mechanics involved in performing an operation.

6. Behavioral creativity. Creative behavior in which the ideational content deals with individual or group relationships, as ordinarily found in persuasive or instructional situations in the classroom.

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[8] J. Moss and D. Bjorkquist, "What is Creativity in Industrial Arts?" The Journal of Industrial Arts Education, 24 (January-February, 1965), 24-27.

Overview of the Study

The population-sample included 129 eighth grade boys receiving instruction in industrial arts in two suburban St. Paul, Minnesota junior high schools during the 1964-65 academic year. Part of this sample was used by Moss[9] in an investigation in which typical classroom performance measures were employed as the criteria of creativity. Use of the same samples enabled a direct comparison of the criterion measures yielded by both studies as well as the utilization of the same *Minnesota Tests of Creative Thinking, Abbr. Form VII* scores and much of the same descriptive test data.

A specialized performance test of creativity (Approach B) based upon the general definition of creative abilities in industrial arts developed by Moss (see Appendix B) for his study, was constructed by the investigator and administered to the sample. The *Minnesota Tests of Creative Thinking, Abbr. Form VII* (Approach C) were also administered at approximately the same time. Descriptive data gathered from cumulative records included (a) verbal intelligence scores, (b) non-verbal intelligence scores, (c) average grades in seventh grade English, social studies, mathematics, industrial arts, and art, (d) achievement test scores in reading, social studies, writing, mathematics and science. At the end of the nine week grading period, during which testing was conducted, two cooperating industrial arts teachers completed a personality rating scale for each student participating in the study (see Appendix A).

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[9] *Ibid*.

Pearson product-moment correlational techniques were employed to estimate the concurrent validity of the Minnesota Tests of Creative Thinking, Abbr. Form VII, and to ascertain the relationships between criterion measures derived from Approaches A and B. Correlations were also computed to reveal the relationships computed among all variables in the sample.

In addition, multiple regression equations were developed to ascertain which combination of Approach C variables would best predict each of the Approach B criterion measures.

The separate variables used in this study are enumerated below:

A. Classroom Performance Measures of Creative Abilities (Approach A)

X_1	Figural Unusualness
X_2	Total Unusualness
X_3	Figural Creativity
X_4	Total Creativity

B. Specialized Performance Test Measures of Creative Abilities (Approach B)

X_5	Symbolic Unusualness
X_6	Symbolic Creativity
X_7	Figural Unusualness
X_8	Figural Creativity
X_9	Behavioral Unusualness
X_{10}	Behavioral Creativity
X_{11}	Total Unusualness
X_{12}	Total Creativity

C. Minnesota Tests of Creative Thinking, Abbr. Form VII Measures (Approach C)

X_{13}	Total Non-verbal

X_{14} Total Verbal

X_{15} Grand Total

X_{16} Total Fluency

X_{17} Total Flexibility

X_{18} Total Originality

X_{19} Total Elaboration

X_{20} Total Inventivlevel

X_{21} Fluency, Verbal

X_{22} Fluency, Non-verbal

X_{23} Flexibility, Verbal

X_{24} Flexibility, Non-verbal

X_{25} Originality, Verbal

X_{26} Originality, Non-verbal

X_{27} Elaboration, Verbal

X_{28} Elaboration, Non-verbal

D. Post Facto Teacher Ratings of Creativity

X_{29} Average Teacher Rating

E. Achievement and IQ Measures (Descriptive data)

X_{30} Verbal IQ (Lorge Thorndike)

X_{31} Non-verbal IQ (Lorge Thorndike)

X_{32} Triggs Diagnostic Reading, Form A

X_{33} STEP Social Studies, Form A

X_{34} STEP Writing, Form 3A

X_{35} Snader Mathematics, Form AM

X_{36} Read Science, Form AM

X_{37} Avg. I. A. Grade, Grades 7 and 8

X_{38} Avg. English Grade (7)

X_{39} Avg. Social Studies Grade (7)

X_{40} Avg. Mathematics Grade (7)

X_{41} Avg. Industrial Arts Grade (7)

X_{42} Avg. Science Grade (7)

X_{43} Avg. Art Grade (7)

X_{44} Avg. 7th Grade

F. Teacher Perceptions of Student Personality

X_{45} Self confidence

X_{46} Temperament

X_{47} Sociability

X_{48} Masculinity

X_{49} Impulsiveness

X_{50} Courtesy

X_{51} Cooperation

CHAPTER II

RELATED LITERATURE

A complete review of research in creativity would fill several volumes. This chapter, therefore, is of necessity, limited to reporting studies which are direct antecedents of this investigation.

Some Approaches to the Measurement of Creativity

Mental abilities approach: Guilford. Since 1950, Guilford[10] has concentrated on the identification of factors of creative ability, the development of instruments to evaluate such factors, and the validation of these instruments in terms of the creative productivity of scientific personnel. Guilford originally hypothesized that creative thinking involved seven separate, distinct abilities; sensitivity to problems, fluency of ideas, flexibility of thinking, originality, the ability to analyze information, the ability to synthesize information, and the ability to redefine. By using a factor analytic approach he sought to place his research on creativity within a larger context of the structure of intellect. Noting some 47 factors of intellect (presently increased to over 60), Guilford[11] proposed that these factors be organized into a three dimensional model according to (a) the kind of material or content of thought, (b) the basic nature of the operation being performed, and (c) the type of product which was resultant when a certain operation was applied to a certain type of content.

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[10] J. P. Guilford, R. C. Wilson and P. R. Christiansen, A Factor Analytic Study of Creative Thinking, II Administration of Tests and Analysis of Results. Reports From the Psychological Laboratory, No. 8, (Los Angeles: University of Southern California, 1952).

[11] J. P. Guilford, "Traits of Creativity," In H. Anderson (Ed.), Creativity and Its Cultivation. (New York, N. Y.: Harper and Co., 1959), 142-161.

Guilford, through his factor analytic studies, has sought to determine the relationship between creative abilities and other types of intellectual abilities. The general approach which he has taken to the measurement of mental abilities has been to develop separate tasks for the measurement of each ability. To date, some 141 tasks are being used in the measurement of 53 mental abilities. It is probable that, through a process of instrument refinement, fewer tasks will be required to assess the present group of known mental factors.

Complex tasks approach: Torrance. Torrance,[12] using a somewhat different approach than that taken by Guilford, has developed sets of creative thinking tasks which are presumed to require use of the creative process. An examination of the responses to each task has revealed evidences of various types of creative thinking abilities. The Torrance tasks are paper and pencil tests, each of which is scored in several ways in order to obtain measures of different abilities involved in the creative process.

To date, over twenty-five tasks, appropriate to a wide range of grade levels, have been developed, together with scoring guides and data from experimental administrations. These tasks have been constructed so that (1) solutions to problems necessitate degrees of divergent thinking, (2) credit can be awarded for multiple responses, and (3) responses may be of a verbal or non-verbal nature.

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[12] E. P. Torrance, Guiding Creative Talent, (Englewood Cliffs, N. J.: Prentice-Hall, Inc., 1962). 44-64.

Creative products approach. A third approach to the measurement of creative thinking abilities has been through a study of the nature and scope of creative products generated by scientific and artistic personnel. Measures of typical performance are sought; that is, how do the workers who produce creative products differ from their less creative co-workers? The use of products as a criterion for creativity has been most frequently encountered in investigations having technological or industrial settings. In such investigations, creative thinking is usually considered to be a unitary trait which is distributed in the population in a manner comparable to intellectual or personality traits.

McPherson,[13] by investigating the studies utilizing the creative products of scientists, found that the majority of studies used one or more of eleven criteria to identify the creative products of scientific personnel. These were patents, patent disclosures, publications, unpublished research reports, imprinted oral presentations, improved processes, new instruments, new analytical methods, ideas, new products and new compounds. He reported that the most frequently used criteria have been patents and publications.

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[13] J. H. McPherson, "A Proposal for Establishing Ultimate Criteria for Measuring Creative Output," In C. W. Taylor (Ed.), The 1955 University of Utah Research Conference on the Identification of Scientific Talent. (Salt Lake City, Utah: University of Utah Press, 1956).

Bloom[14] found that, of 100 Ph.D. graduates who had received degrees at least eight years ago, 10 percent accounted for two-thirds of the research publications credited to the group. By observing the number of times an individual was mentioned in the Annual Review of Physiology over a period of three years, Pelz[15] sought to identify the more creative individuals in the medical field. The number of operation improvement suggestions which were accepted by the U. S. Air Force was used by Chorness[16] as a criterion for measuring scientific accomplishments of personnel. Owens, Schumacher and Clark,[17] seeking to predict creativity in machine design, used the criterion of people who had actually demonstrated the ability "to produce a novel, ingenious or original solution in the form of a total, functional and practical mechanism."

That creative thinking can best be studied through a product approach is a feeling shared by a majority of investigators. The substance of the Committee Report on Criteria of Creativity, presented by Gamble[18] at the 1959 University of Utah Research Conference, indicated that the number one objective of a study of creative behavior should be an investigation of creative products. After such products are judged creative, the term may be applied to both the behavior which produced such products and to the individual who performed the creative act. Taylor[19] points out that distinctions among problem solving, decision making, and creative thinking can best be made in terms of the product. Large numbers of measures were refined by that investigator to yield multiple scores for groups of research scientists. Included in the refined measures were supervisor, peer, examiner and self evaluations of products, counts of reports and publications, official records, and membership in professional societies.

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[14] B. S. Bloom, "Report on Creativity Research at the University of Chicago," In C. W. Taylor (Ed.), The 1955 University of Utah Research Conference on the Identification of Creative Scientific Talent, (Salt Lake City, Utah: University of Utah Press, 1956), 182-194.

[15] D. C. Pelz, "Relationships Between Measures of Scientific Performance and Other Variables," In C. W. Taylor (Ed.), The 1955 University of Utah Research Conference on the Identification of Creative Scientific Talent, (Salt Lake City, Utah: University of Utah Press, 1956), 53-61.

[16] M. H. Chorness, "An Interim Report on Creativity Research," In C. W. Taylor (Ed.), The 1955 University of Utah Research Conference on the Identification of Creative Scientific Talent, (Salt Lake City, Utah: University of Utah Press, 1956), 132-155.

[17] W. A. Owens, C. F. Schumacher, and J. B. Clark, "The Measurement of Creativity in Machine Design," In C. W. Taylor (Ed.), The Second (1957) University of Utah Research Conference on the Identification of Creative Scientific Talent, (Salt Lake City, Utah: University of Utah Press, 1957), 129-140.

Emphasis on the creative person. Rather than concentrating attention upon the creative product, a small group of investigators have centered their emphasis on a study of the originators of such products. Eminently creative persons are generally selected by a panel of experts from Who's Who types of publications, or on the basis of peer or supervisor ratings. Exhaustive studies are then undertaken in order to ascertain the manner in which the highly creative person differs from his less creative peers. Several investigators have gone a step further and have proceeded to develop life history studies in an attempt to relate creativity to such variables as parental influence, childhood activities and interests, socioeconomic status and educational status.

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[18] A. O. Gamble, "Suggestions for Further Research," In C. W. Taylor (Ed.), The 1959 University of Utah Research Conference on The Identification of Creative Scientific Talent, (Salt Lake City, Utah: University of Utah Press, 1959), 292-297.

[19] D. W. Taylor, "Environment and Creativity," In Conference on the Creative Person, (Berkeley, Calif.: University of California, Institute on Personality Assessment and Research, 1961), Chap. 8.

MacKinnon[20] utilized a sample of architects as subjects for his investigation of creative persons because, as a group, he found them to be "generally characteristic of creative adults." "Architecture," he states, "as a field of human endeavor, requires that the successful practitioner be both artist and scientist;--artist in that his designs must fulfill the demands of 'Delight', and scientist in that they must meet the demands of 'Firmnesse' and 'Commodity', to use the words of Sir Henry Wotton[21] (1624)." The successful architect, he points out, must "combine, reconcile, and exercise the diverse skills of businessman, lawyer, artist, engineer and advertising man, as well as those of author and journalist, psychiatrist, educator, and psychologist." The multifarious expressions of creativity can be observed best, he feels, in a profession such as architecture, where opportunities for expression of creative thinking are both numerous and of a diverse character. A majority of the investigations of eminently creative persons have been conducted on populations which represented either the arts or sciences; hence any conclusions reached might be applicable only to such populations.

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[20] D. W. MacKinnon, "The Nature and Nurture of Creative Talent," American Psychologist, 17 (July, 1962), 484-495.

[21] H. Wotton, The Elements of Architecture, (London: John Bill, 1624), as reported in D. W. MacKinnon, Ibid., 486.

A problem encountered in studies of distinguished, creative, mature adults has been that of interpreting the findings in terms of what such persons were like at various stages of development. It is indeed one thing to discover certain traits which characterize eminent adults and quite another matter to conclude that those traits characterized the same individuals when they attended elementary school, high school, or college. Nor can we assume that the discovery of such traits in school age youth would necessarily identify those who are destined to become eminently creative adults. Such issues can be settled only when longitudinal types of studies are carried out, and, to date, there appears to be little interest in such a research approach. It should not be overlooked, however, that the fostering of creativity among those children who possess the traits of eminently creative adults, may prove to be a rewarding approach.

Life history studies of eminently creative persons have been further complicated by the fact that such investigations are generally based upon self-reports which are subject to misperceptions and self deceptions. MacKinnon[22] points out the seriousness of this problem when he states:

> Even if we were to assume that their testimony is essentially accurate, we would still have no assurance that the conditions in the home, in school and in society, the qualities of interpersonal relations between instructor and student, and the aspects of the teaching-learning process which would appear to have contributed to creative development a generation ago would facilitate rather than inhibit creativity if these same factors were created in today's quite different world and far different educational climate.

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[22] D. W. MacKinnon, Ibid., 491.

Because of the rather severe limitations on the "creative persons approach" to the study of creativity, virtually all educational researchers have chosen other methods of investigation.

Concurrent Validity and Reliability of the Minnesota Tests of Creative Thinking

There appears to be only scattered evidence concerning the concurrent validity of various batteries of the Minnesota Tests of Creative Thinking. Sommers,[23] in collaboration with the Bureau of Educational Research at the University of Minnesota, conducted a study to estimate the validity of the Test of Imagination, Form D, using creativity in industrial design as a criterion measure. Two groups, one rated as creative by members of an industrial education college faculty, and the other group rated as non-creative, were given the Test of Imagination. A mean score of 237 on the battery was attained by the high creative group compared with a mean score of 179 for the low creative group. The difference in means was significant at less than the .05 level.

Moss,[24] at the University of Minnesota, conducted a pilot study directed toward estimating the validity of the Minnesota Tests of Creative Thinking, Abbr. Form VII for measuring the creative abilities of eighth grade students in industrial arts classes. Criterion teachers rated student products as they occurred in typical classroom situations, according to the usefulness and unusualness of the product. Findings indicated that "coefficients were not sufficiently high to consider measures from the MTCT, Abbr. Form VII (a relatively content-free test battery of primary creative abilities), as satisfactory indices of actual figural creativity output in industrial arts." It was observed by Moss, however, that low, but statistically significant relationships were found between his measures of figural creativity and certain MTCT, Abbr. Form VII measures, and that such relationships were greater than those obtained between MTCT measures and IQ. Greater relationships between MTCT test scores and figural creativity performance were observed as subjects' general school achievement ability approached national norms.

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[23] W. S. Sommers, op. cit., 112-115.

[24] J. Moss, Jr., op. cit., 66.

Wallace[25] in an aforementioned study, investigated the sales performance of 61 saleswomen in relation to their scores on an MTCT battery which included the following tests: Ask and Guess Test, Product Improvement, Unusual Uses (toy dog), Unusual Uses (tin cans), and Circles. Salespeople were identified according to sale productivity as high sale producers and low sale producers, representing the top and bottom one-third of each department. In order to delineate among these salespeople in "creative" jobs from those whose jobs required less creativity, the departments from which these people came were classified as "creative" or "non-creative" according to the amount of customer service required. Findings indicated that (a) there were significant differences (.05) in MTCT scores between women who worked in creative and non-creative departments, (b) high sales producers were significantly more creative than low sales producers, (c) the lowest MTCT scores were received by salespeople with the poorest sales records in departments calling for the least customer service.

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[25] H. R. Wallace, op. cit., 223-226.

In a more recent study, Wallace[26] investigated the validity of certain MTCT measures as predictors of effective performance in selected industrial sales occupations. Tests of creative thinking were administered to selected sales and marketing employees of a large industrial concern. Subjects were then grouped according to both an occupational status and a sales performance criterion. His findings suggested that (1) top level sales and marketing executives and industrial salesmen are more original in producing ideas and in exhibiting curiosity than those sales people who are being prepared for industrial sales positions, (2) salesmen ranking high in self-motivation were "likely to be high, when compared with their co-workers, in three creative thinking abilities: ideational fluency, originality, and figural or non-verbal imagination," (3) industrial salesmen possessing a high degree of technical education "are more prone to elaborate on ideas they express in pictorial or figural form, than are consumer salesmen with relatively little technical training or education."

Torrance[27] has reported a study of validation in which students were asked to experiment with, suggest uses for, and think of scientific principles which could be demonstrated with science toys. Findings indicated the presence of a "linear trend" between five class intervals based on MTCT total scores and the mean number of ideas generated by students within each of the five intervals.

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[26] H. R. Wallace, "Creative Thinking: A Factor in the Production of Industrial Salesmen," (unpublished Ph.D. dissertation, University of Minnesota, 1964).

[27] E. P. Torrance, Guiding Creating Talent (Englewood Cliffs, N. J.: Prentice-Hall and Company, 1962), 50-51.

A study of validity involving peer group nominations was conducted by Torrance,[28] using a population of 459 secondary school students as subjects for the investigation. Early in the term subjects were given a battery of the MTCT which included Product Improvement, Product Utilization, Circles, and the Ask and Guess Test. Later in the same term measures for five different dimensions of creative thinking were obtained through a series of sociometric and peer ratings. Low, but statistically significant relationships between such ratings and MTCT raw scores for fluency, flexibility and inventivlevel in grades eight, nine and ten were observed.

Hansen and Blockhus[29] compared a group of six high scoring business education teachers with an equal number of their less creative peers, based upon classroom teaching behavior and student growth. Teachers having high creativity scores were found to ask more questions, ask a greater variety of questions, give more illustrations of key concepts, and interact more with students. Throughout the term, pupils in the "creative" teachers' classes achieved greater gains in originality, product improvement, unusual uses, consequences and problem situations as measured by the MTCT.

Torrance and Hansen[30] sought to validate a battery of the

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[28] E. P. Torrance, Role of Evaluation in Creative Thinking, Project No. 725, Cooperative Research Branch, United States Office of Education, (Minneapolis, Minn.: Bureau of Educational Research, University of Minnesota, 1964), 53-54.

[29] Reported by E. P. Torrance, op. cit., 54.

[30] E. P. Torrance and E. Hansen, "The Question-Asking Behavior of Highly Creative and Less Creative Basic Business Teachers Identified by a Paper-and-Pencil Test," Psychological Reports, 17, 1965, 815-817.

MTCT by examining the relationship between creativity test scores and "divergent power" scores assigned to questions asked by teachers in class. These investigators delineated groups of high creative and less creative teachers on the basis of the MTCT, Form DX. Using a classroom observation technique, a record was made of the questions asked by the teacher throughout a semester period. These questions were then evaluated for Divergent Power according to the Burkhart-Bernheim scoring system. The mean Divergent Power score as well as the percentage of divergent questions asked was found to be considerably higher for the high creative group than for the less creative group.

Test-retest reliabilities have been reported both for MTCT batteries and for the separate tests. Correlation coefficients have averaged approximately .80 for the total Abbr. Form VII battery.[31] With a time interval of approximately two weeks between tests, the Circles Test averaged .60 to .79; Unusual Uses (tin cans), .60 to .75. The Product Improvement Test (toy dog) averaged .76 to .85 with an elapsed time interval of six months. A correlation coefficient of .80 for figure completion was obtained by using alternate forms of the Figure Completion Test. Inter-scorer reliabilities of all factors for all tests have ranged from .87 to 1.00, with an average in excess of .90.[32]

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[31] E. P. Torrance and J. C. Gowan, The Reliability of the Minnesota Tests of Creative Thinking, Research Memorandum BER-63-4 (Minneapolis, Minn.: Bureau of Educational Research, University of Minnesota, 1963), 3.

[32] E. P. Torrance, Role of Evaluation in Creative Thinking, op. cit., 50-65.

Relationships Among Achievement, Intelligence and Creativity

Achievement and creativity. The need to understand the relationship between academic achievement and creative thinking abilities is pressing, for such knowledge is essential to the proper development of educational practice. Because of much evidence supporting a high positive relationship between IQ and school achievement, investigators have, until recently, given their attention to IQ and creativity, assuming similar relationships existed for achievement and creativity. Recent studies suggest, however, that these relationships may be more complex than were originally anticipated.

Holland[33] sought to find the relationships between three criteria of academic and creative performance, using a sample of 9,868 high school juniors who were Merit Scholarship Finalists. The criterion of academic performance was high school grades during the first three years of school. The criteria of creative performance were derived from a checklist of accomplishments assumed to require creative or original behavior, i.e., publications, awards, prizes, patentable devices, etc. Checklist items were divided by content into two scales, creative science and creative arts. The influence of intelligence was partialled out, using the Scholastic Aptitude Test as an estimate of intelligence for all three criteria. Findings suggested that a negligible relationship existed between academic aptitude and both types of creative performance among exceptionally bright students. Correlational analysis between selected variables of personality and performance implied that:

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[33] J. L. Holland, "Creative and Academic Performance Among Talented Adolescents," Journal of Educational Psychology, 52 (June, 1961), 136-147.

> ". . . academic achievement involves somewhat different motives than creative performance; good grades in high school appear to be a function of socialization and perserverance, whereas creative performance is a function of conscious concern with high accomplishment, independence and originality."

In an investigation conducted by Getzels and Jackson,[34] attempts were made "to discover significant variables which differentiated the creative from the intelligent students" enrolled in a large private high school. The measures of intelligence used were *Stanford Binet*, *WISC* or *Henman-Nelson* scores converted to comparable *Stanford Binet* IQ's. Five creativity tests were adapted from Guilford, Cattell or were constructed by the investigators. On the basis of mean scores from the five creativity measures and IQ scores, two groups were delineated; (1) a group consisting of students in the top 20 percent in creativity, but not in the top 20 percent in IQ, (2) a group consisting of students in the top 20 percent in IQ, but not in the top 20 percent in creativity.

The two groups were compared with each other and to the total school population on standardized achievement test measures. Mean IQ's of 132, 150 and 127, respectively, were reported for the total population, high IQ group and high creativity group. Mean achievement scores reported for those groups were 49.91, 55.00, and 56.27, respectively. It was observed that (1) both the high creativity and high intelligence groups surpassed the total population on mean achievement and (2) there was no significant difference in achievement means between the high creativity and high intelligence groups. The investigators concluded that "despite the striking differences in mean IQ, the creative and the intelligent groups were equally superior to the total population in school performance as measured by standardized achievement tests."

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[34] J. W. Getzels and P. J. Jackson, *Creativity and Intelligence*, (New York, N. Y.: John Wiley and Sons, Inc., 1962). 1-132.

Torrance,[35] by following the Getzels-Jackson design, provided evidence that the same relationships observed for a high school population also held for an elementary school population. In this investigation, IQ's for the high intelligence group and high creativity groups were 152.0 and 126.5, respectively, a difference of 25.5 IQ points.

Another approach utilized by Torrance[36] was a replication of the Getzels-Jackson study, using different populations with varied IQ levels. Seven populations were investigated including a laboratory elementary school, a small college town elementary school, a metropolitan parochial elementary school, a metropolitan public elementary school, a laboratory high school, a summer guidance institute, and a graduate level psychology class. IQ levels ranged from 100 to 150 for these populations, but findings indicated that for five out of the seven populations, the highly creative groups performed as well as the highly intelligent groups. The two exceptions were the small college town elementary school, and the metropolitan elementary parochial school, where better performance was reported for the high IQ groups. The mean IQ for those two populations was approximately 100, and it was pointed out that the curricular emphasis at those two schools was on traditional learning rather than on learning activities which emphasized a need for divergent thinking.

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[35] K. Yamamoto, "Creativity and Intellect: Review of Current Research and Projection," Paper presented to the Minnesota Psychological Association, April, 1961 (Minneapolis, Minn.: Bureau of Educational Research, University of Minnesota), 10.

[36] E. P. Torrance, Guiding Creative Youth, op. cit., 54-64.

Investigations by Gilbert,[37] Nuss[38] and others support the findings of Getzels and Jackson, and Torrance. Virtually all of the investigations on the relationship of school achievement with creativity are tied in with the effect of intelligence. The tone of recent research suggests that, in the higher IQ ranges, the more creative student is also the higher achiever. In normal IQ ranges, however, the relationship does not necessarily hold true.

IQ and Creativity. The mere accumulation of knowledge does not appear to be sufficient for creative performance. To date a majority of studies have implied that the relationship between IQ and creativity is rather low (.20 to .40) for unselected populations and approaches zero for more homogeneous, high intelligence populations.[39]

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[37] J. M. Gilbert, "Creativity, Critical Thinking and Performance in Social Studies," (unpublished Ed.D. dissertation, University of Buffalo, 1961).

[38] E. M. Nuss, "An Exploration of the Relationship Between Creativity and Certain Personal-Social Variables," (unpublished Ed.D. dissertation, University of Buffalo, 1961).

[39] C. W. Taylor and J. W. Holland, "Development and Application of Tests of Creativity, "Review of Educational Research, 62 (February, 1962), 93.

Ahrens[40] administered a MTCT battery and four Guilford-type tasks of creativity to a group of 816 fifth grade elementary school students having a mean IQ of 111. The correlation coefficients between creative thinking abilities and IQ, as measured by the California Test of Mental Maturity, Elementary Short Form, ranged from .11 to .43. The highest coefficients were found between MTCT flexibility and Language IQ, and the lowest between MTCT fluency and Non-language IQ. Correlation coefficients between creative thinking abilities and achievement ranged from .10 to .38. MTCT flexibility scores correlated most highly with achievement, and fluency scores yielded the lowest correlation coefficients with achievement.

Using subjects from an undergraduate college population, Lucht[41] administered a battery of the MTCT, tests of vocabulary, logical reasoning and rote memory. Subjects were classified into high and low ability groups on the basis of both creativity and intelligence. The correlation coefficients found between creativity scores, intelligence variables and achievement measures were of a uniformly low order "suggesting a relative independence between creative thinking abilities, mental ability and achievement measures." The investigator concluded that "grade point average, knowledge and intelligence measures are poor predictors of creativity."

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[40] D. F. Ahrens, "A Study of Educational Achievement in Relation to Creative Thinking Abilities and Intellectual Ability," (unpublished Ed.D. dissertation, University of Illinois, 1962), 42-44.

[41] W. E. Lucht, "Creativity, a Study of Relationships," (unpublished Ph.D. dissertation, State University of Iowa, 1963).

Barron[42] reported a correlation of .33 between originality scores and general intelligence scores on the Concept Mastery Test for a sample of 100 air force officers. A correlation coefficient of .39 was obtained by Flanagan[43] between his measures of "ingenuity" and measures from the Guilford-Zimmerman General Reading Test for a group of 116 summer session students at a military academy. McKinnon[44] found a correlation coefficient of -.08 between intelligence and creativity for a group of architects having a mean score of 113 on the Terman Concept Mastery Test.

A recent criticism made by some investigators is that findings which point to a low relationship between IQ and creativity have generally been based upon data from populations with restricted IQ ranges. Generally, it is argued, such investigations have been limited to the study of individuals with high IQ's. Limiting the IQ variance among subjects studied could lead to mistaken inferences concerning the relationship between intelligence and creative thinking abilities in groups where intelligence is distributed in a manner more representative of that found in the school classroom.

In an effort to discover the relationships between various intelligence levels and creative thinking ability, Ripple[45] and

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[42] F. Barron, "Originality in Relation to Personality and Intellect," Journal of Personality, 25 (December, 1957), 730-747.

[43] J. C. Flanagan, "The Relation of a New Ingenuity Measure To Other Variables," In Taylor, C. W. (Ed.) The Third (1959) University of Utah Research Conference on the Identification of Creative Scientific Talent, (Salt Lake City, Utah: University of Utah Press, 1959), 104-123.

[44] D. W. MacKinnon, op. cit., 484-495.

[45] R. E. Ripple and F. B. May, "Caution in Comparing Creativity and IQ," Psychological Reports, 10 (February, 1962), 229-230.

May delineated four groups based upon IQ; low homogeneous, average homogeneous, high homogeneous and heterogeneous. Subjects were administered the Otis Quick Scoring Mental Ability Test, two tests of creative thinking adapted from May, and seven tasks adapted from Guilford. Results indicated that higher correlation coefficients were achieved between the heterogeneous group and creativity measures than between any other experimental group and measures of creativity. The authors concluded:

> "It appears evident that IQs are not effective predictors of creative thinking abilities among student populations which are fairly homogeneous with respect to intelligence. However, IQs do seem to be somewhat effective in predicting creative thinking performance in more representative student populations, that is, student populations which are considerably heterogeneous with respect to intelligence."

Gardner,[46] using as a sample the entire seventh grade of a cooperating school district, investigated the relationship of IQ and creative thinking for average IQ populations. The relationship between IQ scores yielded by the California Tests of Mental Maturity and creative measures from a battery of seven of Guilford's divergent thinking tasks was found to be highly significant. The conclusion was offered that "except perhaps in the case of children with very superior IQ scores, general intelligence would appear to be a major influence on creativity."

Price[47] sought to investigate the predictive value of IQ on creativity by classifying students, aged twelve to fifteen, into three levels, with mean IQs of 100, 130 and 148. Subjects were administered a battery of five Guilford tests of creative thinking. The Stanford Binet test was used as the measure of intelligence. An examination of the relationships suggested the following two conclusions:

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[46] S. F. Gardner, "Creativity in Children, A Study of the Relationships Between Temperament Factors and Aptitude Factors Involved in the Creative Ability of Seventh Grade Children with Suggestions For a Theory of Creativity," (unpublished Ph.D. dissertation, University of Southern California, 1963).

[47] M. B. Price, "The Relationship of Age, Mental Age, IQ and Sex to Divergent Thinking Tests," (unpublished Ph.D. dissertation, Claremont Graduate School, 1963).

(1). The data supported the common assumption that IQ is associated with divergent thinking over a wide range of ability.

(2). The data supported the use of a cut-off point of 130 IQ for screening potentially creative people.

In another effort to study the predictive value of IQ on creativity for normal populations, Altenhaus[48] administered five creativity tests from the Getzels and Jackson battery, the California (Short Form) Test of Mental Maturity, and the Iowa Tests of Basic Skills to 162 sixth grade children from a normal population. Findings indicated that (a) a significant linear relationship existed between measures of creativity and IQ, (b) IQ tended to be a somewhat better predictor of school achievement than did creativity, (c) high scoring students on measures of both creativity and IQ tended to score significantly higher than those students who were gifted in only one of these areas, and (d) school curricula should be organized to stress both convergent and divergent thinking because both abilities appear to be important for excellence in school achievement.

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[48] C. B. Altenhaus, "An Exploration of the Relationship of Intelligence to Creativity in School Children," (unpublished Ed.D. dissertation, Rutgers University, 1964).

Nuss[49] investigated the relationships among certain variables that were believed to be associated with the manifestation of creative ability. He arranged 335 eighth grade pupils on two distributions according to a double criterion, (a) test results from the administration of Mosing's Multi-media Creativity Test, and (b) teacher ratings of pupil creativity. Four groups were then delineated, (1) High test, high teacher rating, (a) Low test, low teacher rating, (3) High test, low teacher rating, and (4) Low test, high teacher rating. Nuss reported "positive linear relationships" between high creativity and intelligence, and between creativity and achievement.

Gilbert[50] found proficiency in "critical thinking" of a high creative group, as measured by the Watson-Glaser Critical Thinking Test and Outstanding Traits Test, to be significantly greater than the proficiency of a low creative group of eleventh grade students. Use of a partial correlation technique in which intelligence was held constant resulted in a low but significant correlation between creativity and critical thinking at the .01 level. Gilbert concluded that "a comparison of the correlations between teacher marks and creativity scores and the correlation between achievement test scores and creativity scores indicates that there is a significantly greater relationship between the student's creative ability and his performance on achievement tests."

Schmeidler, Nelson and Bristol[51] found that "potentially creative" students, as identified by a group Rorschach test of 633 freshmen at Barnard College, tended to be more intelligent than the others and also received more honors. Kheiralla[52] concluded from his study of 208 boys and girls in grades 4, 6, 8, 10 and 12, that "the creative child is in most cases a person of superior or gifted mental capacity as measured by intelligence tests." Rambo[53] found evidence that retarded pupils who are high on creativity, score higher on achievement tests in reading and social studies than retarded pupils who are low on creativity. An experiment reported by Luker,[54] in which relationships between creativity and intelligence were measured on the basis of scores yielded by the Otis and three Guilford tests, resulted in the finding that "high creatives tend to have greater mental ability than low creatives."

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[49] E. M. Nuss, op. cit.

[50] J. M. Gilbert, op. cit.

[51] G. R. Schmeidler, M. J. Nelson and M. Bristol, "Freshman Rorschachs and College Performance," Genetic Psychology Monographs (59), (February 1959), 3-43.

Research evidence thus far suggests that intelligence, as measured by our present instruments, accounts for only a portion of the variation in actual creative performance and by itself is not an adequate measure of creative abilities. McKinnon[55] sums up the present status of research on the relationship between intelligence and creativity when he states:

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[52] S. M. H. Kheiralla, "The Relationship Between Creativity and Intelligence, Achievement, Physical Growth, Certain Personality Traits and Certain Reading Habits in Elementary and Secondary School Children," (unpublished Ph.D. dissertation, University of Michigan, 1963).

[53] F. L. Rambo, "Pupil Characteristics Related to Creativity," (unpublished Ed.D. dissertation, University of Georgia, 1964).

[54] W. A. Luker, "The Relationship Between Personality Integration and Creativity," (unpublished Ed.D. dissertation, North Texas State University, 1963).

[55] D. W. McKinnon, op. cit., 488.

> Over the whole range of intelligence and creativity there is, of course, a positive relationship between the two variables. No feeble-minded subjects have shown up in any of our creative groups. It is clear, however, that above a certain required minimum level of intelligence which varies from field to field, and in some instances may be surprisingly low, being more intelligent does not guarantee a corresponding increase in creativeness. It just is not true that the more intelligent person is necessarily the more creative one.

That relationships between the so-called divergent and convergent mental abilities do exist but that such relationships may be considerably more complex than our earlier research has suggested is pointed out by DeMille[56] when he states:

> By now almost every writer in the field of creativity has written that IQ is not an adequate indicator of creativity. Some have even suggested that a high IQ may somehow be incompatible with creativity. That is nonsense. Intellectual abilities tend to go together, even though they may not be highly correlated at all levels. Recent observations suggest that we are not likely to find great capacity for flexible or original thinking or for extrapolation or redefinition in school children who have low or even average IQ's. In other words, low IQ predicts low creativity. The opposite relation, however, does not hold; high IQ does not predict high creativity. A school child with a high IQ may or may not be high in creativity . . . .

Relationships Among Traits of Personality and Creativity

The commonly accepted measures of intelligence and school achievement appear to have added to the confusion surrounding creativity rather than serving the purpose of helping to identify creative persons. Previously cited studies have suggested that, given a certain minimum intelligence level, accurate prediction of creative performance is dependent upon more unique factors of intellect or achievement than are yielded by conventional instruments. In an effort to discover better predictive indices of creativity, attention has been turned toward an examination of relationships between traits of personality and creativity.

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[56] R. DeMille, "The Creativity Boom," Teachers College Record, 65 (December, 1963), 201.

Study of the "creative personality" has generally been divided into (a) investigations of motivation for creative behavior, and (b) the study of life patterns or personality characteristics of creative persons. The former group of studies are primarily of a psychoanalytic nature and have, as yet, little direct application in the broad field of education. Virtually all investigations concerned with creativity and the educative process have taken the second approach, assuming the pre-existence of a creative personality, with an emphasis upon discovering the components of such a personality and its relationships to learner productivity.

The comparative studies of the personality attributes of creative students tend generally to contrast criterion groups on either test performance, use of projective techniques, self or other's descriptions, and life history material. The criterion groups have generally been selected on the basis of teacher ratings of creativity, performance on creativity tests or by nomination of individuals of outstanding creativity by a panel of experts. Educational research on the creative personality has most generally taken the form of relational type studies containing numerous variables, including intellectual as well as personality characteristics.

Criterion groups contrasted on test performance. A majority of investigators have chosen test performance as a means of classifying attributes of personality. Drevdahl[57] measured a variety of intellectual and personality characteristics by administering Thurstone's Primary Abilities Test, Cattell's Sixteen Personality Questionnaire and several of Guilford's creative thinking tasks to a group of college students. He found that persons possessing a high degree of creative ability tended to be more withdrawn and acquiescent, as well as more sophisticated, radical in their social views, mature, altruistic, and self sufficient than their less creative peers. Creative subjects were divided into art groups and science groups depending upon the nature of creative thinking in which they excelled. It was reported that the arts groups were significantly less stable and controlled, more sensitive emotionally, and more insecure and tense than the science groups. Arts groups were also found to be more egocentric and bohemian than were the science groups.

Rees and Goldman,[58] following the lead of Drevdahl, sought the relationships between art and science oriented creativity and certain personality factors among 200 students at the University of Kansas City. Two objective type personality tests, the Minnesota Multiphasic Personality Inventory and the Guilford-Zimmerman Temperament Survey were used in order to assess personality; the former was used in order to measure traits commonly characteristic of the maladjusted person, and the latter had the advantage of measuring somewhat more unique traits due to its factor-analytic origin. An analysis of differences between the art and science groups indicated that the arts group scored significantly higher on the depression, psychopathic deviate and masculinity scales of the MMPI. The science group scored significantly higher on the GZTS factors of emotional stability and friendliness, but lower on thoughtfulness. The evidence did not support a significant relationship between maladjustment and creativity in either group. Findings for the entire group revealed that the most creative individuals scored lower on factors of restraint and friendliness, and higher on ascendance and aggressiveness.

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[57] J. E. Drevdahl, "An Exploratory Study of Creativity in Terms of Its Relationship To Various Personality and Intellectual Factors," (unpublished Ph.D. Thesis, University of Minnesota, 1954).

[58] M. E. Rees and M. Goldman, "Some Relationships Between Creativity and Personality," Journal of General Psychology, 65 (July, 1961), 145-161.

Garwood[59] classified an original sample of 105 male college science students into "more creative" and "less creative" groups on the basis of a Guilford test battery. Based upon relationships with measures from personality inventories, it was found that the "more creative" group scores were significantly higher than those of the "low creative" group on measures of originality, dominance, participativeness, and flexibility and approached being significantly higher on measures of capacity for status and intellectual efficiency. Lower scores were achieved for the "more creative" group on socialization, desire to make a good impression, and affectionateness.

Findings supporting those of Rees, Goldman, and Garwood were reported by Drevdahl and Cattell[60] in their study of creative artists and writers. The testing instrument, Cattell's 16 PF Questionnaire, provided estimates of sixteen independent personality factors for all subjects. The creative group differed from the normal population in being "somewhat more intelligent, emotionally mature, dominant, adventurous, emotionally sensitive, bohemian, radical, self sufficient, and of a high ergic tension level." They were also less cyclothymic, surgent and subject to group standards of control. The investigators commented that the creative personality appears to be both introverted and bold, both schizothymic and bohemian, yet possessed of high ego strength, high radicalism and emotional sensitivity. Such characteristics, the authors remark, are not characteristic of the pleasant personality, differing quite markedly from the personality of the popular leader or the person who possesses the ability to influence others in face to face situations. They appear to reflect what Riesman[61] describes as characterizing the autonomous person who thinks and acts differently from the unthinking average.

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[59] D. W. Garwood, "Some Personality Factors Relating to Creativity," (unpublished Ph.D. dissertation, Claremont Graduate School, 1961).

[60] J. E. Drevdahl and R. B. Cattell, "Personality and Creativity in Artists and Writers," Journal of Clinical Psychology, 14 (April, 1958), 107-111.

Findings reported in studies of the relationship of personality to creativity sometimes appear quite inconsistent. Part of the reason for such inconsistency may be the result of a failure to give proper attention to the special characteristics of the group, i.e., "art" creativity, "science" creativity, and other characteristics such as mental health, age and maturity. It is notable, for example, that the results reported for investigations of college students, artists and writers, and other adult subjects are quite inconsistent with those found for younger subjects. Reid, King and Wickshire[62] in their investigation of 24 creative and 24 non-creative seventh grade children reported findings in direct contradiction to those of Drevdahl and Cattell. That investigation revealed that creative children tended to be more cyclothymic than schizothymic, and that there was no evidence to support that they were more desurgent than the non-creative children. On the anxiety scale, creative children were found to be less anxious than the non-creative children. This finding was in keeping with Gould's[63] statement that, although many people possess the ability to perform creatively, those who possess good mental health are more likely to give it expression.

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[61] D. Riesman, The Lonely Crowd, (New Haven, Conn.: Yale University Press, 1950), 294.

Several other investigations support the Reid, King and Wickshire findings, possibly suggesting that some of the less desirable personality traits attributed to the creative person may be acquired later in life. Holland,[64] in a previously cited study of National Merit Finalists, found that creative performance at the high school level occurred more frequently among students who were "independent, intellectual, expressive, consciously original, and who had high aspirations for future achievement." Kheiralla,[65] in a previously reported study, found the creative youngster to be characterized by a "high degree of divergent thinking, meditative thinking, a tolerance of ambiguity, and self confidence, together with a low degree of orderliness and discipline. In a study by Rivlin,[66] the high school student selected by the teacher as creative emerged as a rather sociable individual. He was rated by his peers as more popular and creative than his non-creative counterparts. Results of an investigation by Luker[67] indicate that highly creative youngsters have a more integrative personality than do the low creatives.

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[62] J. B. Reid, F. J. King and P. Wickshire, "Cognitive and Other Personality Characteristics of Creative Children," Psychological Reports, 5 (December, 1959), 729-737.

[63] R. Gould, "Some Comments on Creativity and Mental Health." In C. W. Taylor (Ed.), Research Conference on the Identification of Creative Scientific Talent, Salt Lake City, Utah: University of Utah Press, 1956, 219-221.

[64] J. L. Holland, "Creative and Academic Performance Among Talented Adolescents," op. cit., 136-147.

[65] S. M. H. Kheiralla, op. cit.

Criterion groups contrasted with use of projective techniques. Some experimenters have selected projective tests as instruments to examine the personality of creative individuals. Hammer[68] classified High School Scholarship Art Workshop students as "facile" or "creative" and then administered the Thematic Apperception Test, the Rorschach and a rating scale for determining feelings of emotional stability-instability. The differences in the projective test protocols and rating scales distinguished the initial facile or creative persons. The creative group was identified by the fact that TAT protagonists frequently "went insane, had a breakdown, or lost their mind." Their Rorschach records were distinguished by such responses as "people balancing on a pole," "balancing up there," "animals holding on to something or they will fall," "but this is terrible," "something holding on and balancing," and similar type responses. Hammer concludes, "We may speculate that the art canvas provides the beginning creative artist opportunity to work out a need for balance outside, to make up for feelings of disequilibrium within."

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[66] L. G. Rivlin, "Creativity and the Self Attitudes and Sociability of High School Students," Journal of Educational Psychology, 50 (August, 1959), 147-152.

[67] W. A. Luker, op. cit.

[68] E. F. Hammer, "Emotional Instability and Creativity," Perceptual and Motor Skills, 12 (February, 1961), 102.

A brighter side to the "creative personality" was depicted in an investigation by Schmeidler, Nelson and Bristol.[69] These investigators, by using the Rorschach to gain measures of personality and creativity, reported that potentially creative college students tended to achieve more honors and also voiced stronger opinions of either a favorable or unfavorable nature than their less creative peers.

The expressive nature of the creative person evidenced in studies of artists (Hammer) and college students (Schmeidler, et al.), was also reported by Barron[70] in his investigation of military officers. "Originality" was assessed by using seven measures from a battery assembled by Guilford; personality measures were obtained from several of the more commonly used personality tests as well as the Rorschach, Thematic Apperception Test and from ratings of an assessment staff, using Q-sort procedures, trait ratings and the Gough Adjective Check List. "Originality" proved to be positively related to "scope and complexity as a person, impulsiveness, skepticism, daring and expressive as opposed to suppressive dispositions in personality."

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[69] G. R. Schmeidler, M. J. Nelson and M. Bristol, *op. cit.*

[70] F. Barron, "Some Relationships Between Originality and Style of Personality," *American Psychologist*, 9 (August, 1954), 326.

Another research technique, a study of work similarity among eminent individuals through the use of projective techniques, has been used by several investigators. Roe[71] administered the Rorschach and the Thematic Apperception Test to twenty leading American painters and submitted the protocols for blind analysis. Generally negative findings were reported. The protocols were not recognized as having been done by creative individuals. Positive findings were reported by Prados[72] in a similar type of investigation. Using a sample similar to Roe's, he found that creative artists have some traits in common: (a) a strong drive for achievement, (b) richness of inner interests, and (c) strong sensitiveness and emotional response to the outer world, with lack of adaptability to it.

In still another study by Roe,[73] data from Rorschach and TAT performance of eminent research biologists were studied for evidence of similarity of work style. Roe reported that these subjects were very unaggressive, had little interest in interpersonal relations, were unwilling to go beyond the data presented, and preferred concrete reality to the imaginary." Bloom,[74] using projective techniques with a group of eminent scientists, reported temperamental and personality characteristics similar to those found by Roe.

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[71] A. Roe, "The Personality of Artists," Educational and Psychological Measurement, 6 (Autumn, 1946), 401-410.

[72] M. Prados, "Rorschach Studies on Artists and Painters," Rorschach Research Exchange, 8 (October, 1944), 178-183.

[73] A. Roe, "Psychological Examinations of Eminent Biologists," Journal of Consulting Psychology, 13 (August, 1949), 225-246.

[74] B. S. Bloom, op. cit.

Criterion groups contrasted on the basis of self descriptions. The relationship between self descriptions of personality and creative thinking has been studied by several investigators. Barron[75] reported that subjects who scored high on the Barron-Welch Scale of the Welch Figure Preference Test described themselves as "gloomy, loud, unstable, bitter, cool, dissatisfied, pessimistic, emotional, irritable and pleasure seeking." Low scorers on the BW Scale characterized themselves as "contented, gentle, conservative, unaffected, patient and peaceable." Van Zelst and Kerr[76] related self descriptions of personality to a production criterion and found that the most productive scientists considered themselves as "more original, imaginative, curious, enthusiastic, impulsive, less contented and conventional." MacKinnon's[77] study of architects revealed that the most highly creative architects, as assessed by a panel of experts, described themselves as "inventive, determined, independent, individualistic, enthusiastic and industrious," while the less creative subjects stressed responsibility, sincerity, reliability, dependability, clear thinking, tolerance and understanding.

Teacher bias toward the rating of creativity. Considerable evidence has been accumulated to suggest that personality characteristics which are generally associated with creative thinking may also be influential in causing poor relationships to exist between teachers and pupils. Jex[78] found correlation coefficients from -.07 to -.38 between principal-supervisor ratings and measures yielded by his own "ingenuity" tests for a sample of 54 high school science teachers. He sums up the implications of his investigation:

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[75] F. Barron, "Personality Style and Perceptual Choice," Journal of Personality, 20 (June, 1952), 385-401.

[76] R. H. Van Zelst and W. A. Kerr, "Personality Self-assessment of Scientific and Technical Personnel," Journal of Applied Psychology, 38 (June, 1954), 145-147.

[77] D. W. MacKinnon, op. cit., 487.

> It is provocative that the ability to score high on an ingenuity test is somewhat antagonistic to whatever is involved in high ratings of teachers by principals and supervisors. One wonders whether ingenuity is more apt to be penalized than rewarded in many school systems. Maybe not infrequently, the principals and supervisors want docility in teachers.

Similar findings were reported by Getzels and Jackson[79] for a population of secondary school students. These investigators reported that an adolescent's desirability as a student is not only a function of his academic achievement. Despite the fact that scholastic performance was nearly equal for highly creative and highly intelligent students, teachers preferred high IQ students over average IQ students, but preferred average IQ students over high creative students. Taylor[80] found that scientists who published the most articles, possessed the greatest desire for "discovery", and made the largest number of official suggestions were found to ~~have~~ a below average rate of promotion. It appeared that such individuals paid a price for being judged "uncooperative and inflexible" by their superiors. Holland[81] discovered that the students who were liked the most by teachers were bright, persistent, conscientious, academic achievers and student leaders. In an investigation reported by Tallent,[82] teacher ratings of "self control" for high school boys were significantly correlated with intelligence test scores. Tallent summarized his findings with the statement that "a rating bias may favor students who are distinguished by the ability to persevere at a task, carefulness and accuracy of work, tendency to think before acting, and preference for serious conversation to sports or active games."

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[78] F. B. Jex, "Negative Validities for Two Different Ingenuity Tests," In C. W. Taylor and F. Barron (eds.), Scientific Creativity, Its Recognition and Development, (New York, N. Y.: John Wiley and Sons, Inc., 1964), 299-301.

[79] J. W. Getzels and P. W. Jackson, op. cit., 30-31.

[80] C. W. Taylor, "Identifying the Creative Individual," In E. P. Torrance (Ed.), Creativity, Second Conference on Gifted Children, (Minneapolis, Minn.: Center for Continuation Study, University of Minnesota, 1961), 3-21.

At the elementary level, Torrance[83] found that teachers rated their highly creative students as less industrious and studious than they did the more intelligent, but less creative pupils in the class. Although the mean Stanford Binet score for the highly creative pupils in the study was 25.6 points lower than the mean for the highly intelligent pupils, the Gates Reading and Iowa Basic Skills scores were approximately the same. Torrance theorizes that highly creative youngsters "seem to learn through activities which adults define as regressive or playing around."

Torrance[84] suggests that teachers will find it difficult to foster creative thinking among their pupils as long as they themselves reject the values which support creative thinking. On the basis of a survey carried out over a ten state area, he discovered that parents and teachers in the United States rank "being considerate of others" as being the most desirable of 62 characteristics submitted to them for ranking. Other traits selected as being very desirable were independence of thinking, determination, sense of humor, curiosity, courtesy and promptness. Traits most frequently discouraged by teachers were childishness (regression), emotionality, timidity, being critical of others, stubbornness, negativism, a domineering manner, and disturbing the existing organization. Torrance points out that such traits as being considerate of others, courtesy and promptness, which are highly valued by teachers, may be somewhat incompatible with the creative personality. Perhaps teachers may need to alter their values somewhat if efforts to unshackle the creative potential in students are to be genuinely effective.

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[81] J. W. Holland, "Some Limitations of Teacher Ratings as Predictors of Creativity," Journal of Educational Psychology, 50 (October, 1959), 219-222.

[82] N. Tallent, "Behavioral Control and Intellectual Achievement of Secondary School Pupils," Journal of Educational Psychology, 47 (December, 1956), 490-503.

[83] E. P. Torrance, "The Creative Personality and the Ideal Pupil," Teacher's College Record, 65 (December, 1963), 225.

[84] Ibid., 221-226.

Current status of the literature. A review of the literature suggests that (1) the creative individual expresses considerably more sensitivity than his less creative peers, (2) the expression of this sensitivity may take many different forms, some of which are of an anti-social or otherwise undesirable nature, (3) the less desirable qualities of the "creative personality" are found to a lesser degree among school age youth than among adults.

Although certain general trends in the relationship between personality and creativity are observable, consistent, conclusive evidence has not been forthcoming. A serious defect in existing personality-creativity research stems from the fact that operational definitions of personality variables have lacked precision, if indeed such definitions were even formulated. Many studies have been concerned with vast numbers of personality variables (Holland used 75 variables, Barron, 37 variables) rather than seeking to identify common factors of personality. There appear to be certain theoretically based descriptive concepts such as tolerance of ambiguity, openness to experience, childlike traits, self actualization, etc., which appear again and again in the literature and which deserve further investigation. That a conceptual approach to the problem is sorely needed is brought out by Golann[85] when he states:

> However, it is my belief that the use of theoretically derived personality factors as criterion variables has, because of its own inherent difficulties, been neglected, yet holds the most promise of providing a functional developmental understanding of creativity.

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[85] S. E. Golann, "Psychological Study of Creativity," Psychological Bulletin, 60 (November, 1963), 561.

CHAPTER III

DESIGN OF INSTRUMENTS AND COLLECTION OF DATA

A Definition of Creativity in Industrial Arts

At the onset of this study it was necessary to adopt a definition of creativity which would be applicable to an industrial arts environment and at the same time be compatible with the background of existing theory or research on creative thinking. Such an operational definition for identifying the creative abilities of industrial arts students was developed by Moss[86] at the University of Minnesota (See Appendix B). According to his definition, a student's creative ability is evidenced by (a) the relative degree of unusualness and usefulness of his products (behaviors) and (b) the total number of his creative products. Moss has developed a "usefulness" scale which is based upon the degree to which a problem solution satisfies the requirements of the problem. His "unusualness" scale is based upon the probability of occurrence of a creative idea; the less the probability of occurrence, the more unusual the creative product. The creativity of each product (behavior) is assessed by combining the ratings of usefulness and unusualness.

Moss' "Theoretical Model" was submitted to six specialists in the fields of measurement and educational psychology for critical appraisal. All responses being favorable, the "Theoretical Model" was considered compatible with existing theory and practice. Copies of the "Theoretical Model" were also submitted to a purposive sample of fifty-seven industrial arts teacher educators who were selected on the basis of their prior interest in creativity. Although a number of comments requesting greater clarification were made, all agreed with the major definitions and guidelines of the model.

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[86] J. Moss, Jr., op. cit.

The basic definition as stated in the "Theoretical Model" was found to be acceptable for the purposes of this study, although it was necessary to adapt certain measurement techniques to suit the conditions of this study. Instead of basing unusualness ratings on the probable level of occurrence (See Appendix B, Table 1), the use of a specialized performance test made it possible to derive scores from the actual frequency of occurrence of creative problem solutions. A revision in the method for scoring usefulness was also found to be desirable. Rather than utilizing a usefulness scale which defined the solution in terms of the typical teacher solution, this investigation used a normal distribution of usefulness of test responses from the actual sample. Moss' usefulness scores were assigned by one teacher-rater, while two teams of "experts" were used in this study to evaluate usefulness.

Population-sample

The population-sample included 129 boys in six sections of eighth grade industrial arts at two junior high schools in School District No. 623, Roseville, Minnesota, a suburb of Saint Paul. Selection of this school district was made by a panel of four staff members in the Department of Industrial Education at the University of Minnesota on the basis of (a) the nature and quality of the industrial arts program, (b) the opportunity afforded for creative expression in the classroom, and (c) the amount and type of teaching experience of the industrial arts staff. The above criteria were considered because the same sample was utilized for both this study and a prior investigation by Moss, in which teachers rated student products in a typical classroom situation. Use of this sample enabled a direct comparison of criterion measures as well as a utilization of the same descriptive data.

The suburban Saint Paul area in which this study was conducted was one of rather recent growth; one junior high school was constructed nine years prior to this investigation, the other was six years old. The area is one of relatively high income with nearly one-third of the parents of the sample employed in professional, technical and kindred occupations. When compared with the total United States civilian employment, a larger percentage of parents were represented in professional, managerial, sales and skilled crafts types of occupations, with a smaller percentage represented in farm, clerical, operative and service occupations. For a more detailed description of the occupational distribution of the parents of the sample, see Table 38, page 123.

The racial composition of the entire school population was 99.9 percent White Caucasian with only three students out of a total of 2,240 representing minority groups. Students from minority groups were not represented in the sample used in this investigation. The mean IQ of the total sample was 108.9, as measured by the Lorge-Thorndike Intelligence Test.

Development of Instruments for Approach B

A pilot study of Test Approach B (Specialized performance tests) was completed in June, 1964 at the University of Minnesota

High School, using twenty-one subjects from an eighth grade industrial arts class. On the basis of that study, a workable scale for the evaluation of student products was developed.

At the onset of the pilot study, certain criteria were formulated for the selection of problems to be incorporated in the investigator's specialized performance tests of creativity. These criteria were as follows:

All Types of Problems

1. The content of the problem, whether situational or manipulative, should be concerned with situations, tools, materials, and products, etc., which will be familiar to boys in the eighth grade.
2. Problems presented should be broad enough in scope so that the imagination of the individual should not be inhibited, and yet realistic enough so that the usefulness as a problem solution could be estimated.
3. It is essential that problems should be stated in a manner which would encourage creative thinking on the part of the subjects.
4. The problems must be of a nature so that their solutions characterize typical industrial arts performance.

Symbolic and Figural Only

1. The problem must involve the manipulation of simple tools and materials.
2. The problem must call for only those tool operations with which the student is reasonably familiar.
3. Problems selected must adapt themselves to the use of materials suggested for this test approach.
4. Ideas of a symbolic or figural nature should be used in the problem solution.

Using the above criteria as guidelines for developing evaluative instruments, a process of testing, refining and retesting of instruments culminated in the specialized performance tests of creative thinking used in this investigation. Because the design of instruments and data collection for Approach B were so closely related, in the interest of clarity these topics will be treated as one in the section to follow.

Measurement of Symbolic Unusualness and Usefulness, Approach B

Considerations. The measurement of symbolic creativity presented the problem of how to best evaluate a subject's creative abilities with respect to problems involving content of an aesthetic or abstract quality. This content, in order to characterize the industrial arts, should be related to real tangible objects or aspects of process and design as used in industrial arts.

Because the use of basic tools and materials typifies industrial arts in the eighth grade, it was concluded that the measurement of symbolic creativity should be accomplished by utilizing a specialized performance test which required the use of simple tools and tangible materials. A decision to utilize styrofoam as a problem material was reached because (1) this material can be worked with simple industrial arts tools, (2) it is relatively inexpensive, and (3) this material can be worked very easily, thereby enabling the student to complete an assigned problem in a fifty minute class period.

The test. Each subject was given a 2" x 6" x 8" piece of styrofoam and a kit of tools and materials which contained a knife, rule, special shaping tool, coping saw, half round file, 3/4" gouge, sandpaper, sanding block, 12 short pins, (1"), 6 long pins, (1-3/4"), cardboard, modeling tool and information sheet. All were common tools and materials except the special shaping tool and modeling tool; these are illustrated in Appendix C.

The following instructions were presented to all subjects participating in the study:

> Each of you has received a kit containing a piece of styrofoam and several other tools and materials. You will construct a certain specified object from the piece of styrofoam, using only the simple tools and materials which you have been given. Let me explain about the contents of your box.
>
> (1). Styrofoam. This is the piece of styrofoam from which you will construct your project. If you need a different size, I can cut another piece from this large sheet (hold up a full sheet).
>
> (2). Cardboard. The cardboard is placed on your workbench like this (demonstrate) in order to protect the surface from cuts and scratches.
>
> (3). Knife. The knife is used to cut the styrofoam like this (demonstrate). You can cut through the entire thickness or you can simply slice like this (demonstrate). When slicing the material, take care to cut away from your body in order to avoid injury.
>
> (4). Rule. The rule is used to make measurements and as a straightedge for marking and cutting.
>
> (5). Coping saw. The coping saw can be used to cut the styrofoam into the desired shape. Project the material over the edge of the workbench and saw like this (demonstrate). Do not squeeze the styrofoam in your vise in order to hold it because it is very soft and can easily be damaged.
>
> (6). Gouge. In order to scoop out an irregular surface on the interior of your project, use the gouge like this (demonstrate). Be careful to grasp the material so that the gouge is always being pushed away from the hand holding the styrofoam.
>
> (7). Half round file. This file is flat on one side and partly round on the other. By working the file like this (demonstrate), you can remove excess material left by the previous tools.
>
> (8). Shaping tool. Some areas on your project will require further shaping and smoothing. This tool can get into

intricate places, and do all sorts of operations which can't be done with the other tools (demonstrate).

(9). Sandpaper and sandblock. Styrofoam can very easily be shaped by placing the sandpaper piece around the block and sanding like this (demonstrate), or by using the sandpaper alone (demonstrate).

(10). Modeling tool. This tool can be used to poke holes in the styrofoam and enlarge them like this (demonstrate), or it can be used to compress the material like this (demonstrate).

(11). Pins. If you wish to fasten two pieces of styrofoam together you can do so with pins, like this (demonstrate).

(12). Rubber cement. Another way of fastening styrofoam together is with rubber cement (demonstrate). I have one jar on the desk. You may come up if you wish to use it. Because styrofoam is rather fragile, you may need to use rubber cement to mend broken parts.

(13). Information sheet. On this sheet (hold up) will you please write your name, school, and your teacher's name. In the lines below, there is space to write about your project if you wish to describe it or tell how it works.

The task that you will be doing is that of constructing a container which will hold nuts or fruit. Try to produce a container which is pleasing in design, unusual in appearance, yet useful for the purpose intended. In this project we are more interested in observing your artistic abilities in creating a pleasing product than in your mechanical inventiveness, so please try to plan a project which you consider to be strikingly pleasing and beautiful.

You must remain for the entire fifty minutes, so if you complete your project early, spend some time thinking about how you can improve the design and at the same time make it more beautiful and unusual.

Are there any questions? (answer questions)

You will have 50 minutes. You may begin.

Evaluation of symbolic unusualness. All student products were evaluated for symbolic unusualness with respect to the frequency of occurrence on each of eight primary differentiating characteristics considered by a panel of seven designers, art educators and industrial educators to characterize the important features of a decorative container for holding nuts or fruit. The eight features thought to discriminate unusualness were:

1. The plane view, indicating the basic shape of the container.
2. The shape of the side contour of the product.
3. The thickness of the container lip at the top edge.
4. Support for the container, i.e., legs, base, small feet, flat bottom, etc.
5. Ornamentation.
6. Lifting devices, i.e., handles, finger holes, etc.
7. Relationship of the inside to the outside contour of the container.
8. Placement and number of divisions, trays, units.

Several of the experts who contributed to the selection of the above categories pointed out that the appearance of a nut or fruit container is necessarily influenced by a balance of a combination of these discriminating features, and that placing stress upon individual categories in isolation from one another would be unwise. It should therefore be pointed out that the purpose of this measurement was only to evaluate unusualness, and that the aesthetic considerations reflecting "usefulness", in terms of the container's decorative appeal, i.e., desirability to possess such an object, will be considered in a subsequent evaluation.

The unusualness of all products was evaluated by the investigator with respect to the type of solution offered for each of these eight distinguishing features, the scores being determined by the frequency of occurrence of such characteristics. Characteristics found very frequently, therefore, contributed to low scores for a particular product, and those found less frequently contributed to higher scores.

The system devised for rating these products was to break down each of the eight main categories into sub-categories which were descriptive of variations in the manner of solving a particular problem. For example category No. 1 (Plane view) was broken down into (a) round, (b) oval or eliptical, (c) rectangular, (d) square, (e) four straight sides, not rectangular, (f) five sides, (g) six sides, (h) eight sides, (i) free form, no symmetry, (j) free form, symmetrical, (k) rectangular with rounded corners, (l) diamond, and (m) resembles an object.

The sub-categories were formulated simply by examining the products and forming sub-categories into which all products could be classified. It would have been possible to formulate more or less sub-categories, of course, depending upon the distinctions drawn among such features. For example, since a square is also a rectangle, category No. 14 could have been eliminated and those products which were square, included in the rectangular category. However, only one subject out of a total of 129 conceived of a square container, and to lower his rating by placing him in a category characterized by a distinctly different basic shape would have the effect of penalizing the more unusual response.

Likewise, instead of formulating separate sub-categories for five, six and eight sided objects, a category entitled "more than four sides" might have been substituted. Such a category made by lumping three sub-categories together would have included eighteen cases, resulting in a poorer rating for these products than for those having a conventional rectangular shape (fifteen cases), the latter group consisting of products which reflected the original shape of the styrofoam as it was first distributed to the subjects.

The procedure used in establishing sub-categories was of necessity, subjective. This procedure was based upon a panel of experts' decisions concerning the selection of sub-categories which were relatively discreet and of equal importance in the differentiation of possible solutions within each major category. Categories were constructed so that they were mutually exclusive and exhaustive, i.e., every product could be classified under one of the sub-categories, and it was impossible for the same product to be placed in each of two or more sub-categories.

Tables 1 through 8, pages 60 to 68, present the frequency data for features of symbolic unusualness, categories 1 through 8. In the left hand column, entitled "sub-category", are listed the various mutually exclusive classifications which describe the physical features of the products. In the column entitled "frequency" are listed the total number of products out of a total of 128 which exhibited that particular characteristic. (One subject out of the total of 129 misunderstood directions and constructed a nutcracker rather than a container for nuts. This product therefore, could not be rated.) The higher the frequency of occurrence, the less unusual the product, hence high frequencies reflect low unusualness ratings and vice versa.

Following the determination of frequency scores, the next step was the determination of weights which should be assigned to each of the eight main categories of symbolic unusualness. The

Table 1

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 1: Plane View, Basic Shape

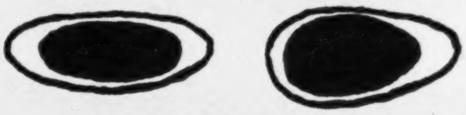
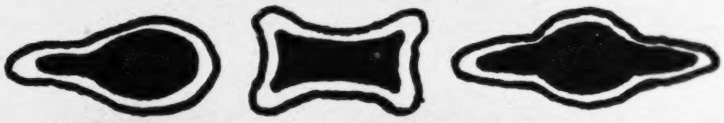
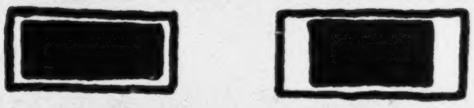
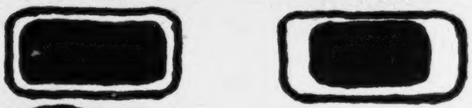
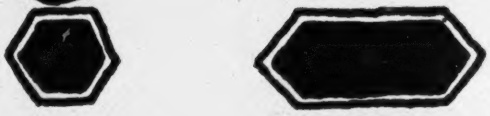
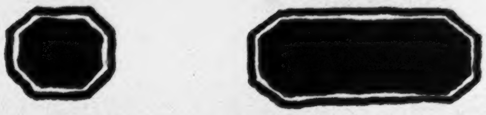
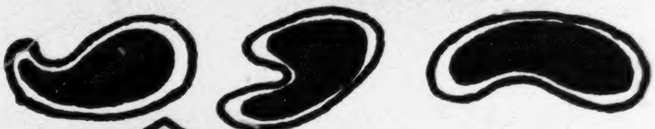
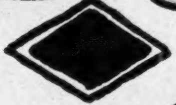
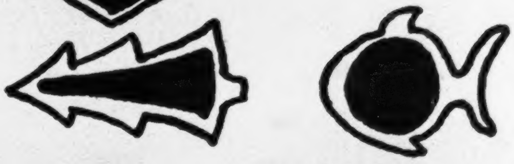
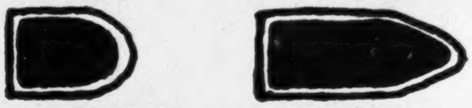
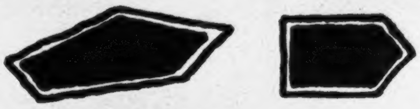
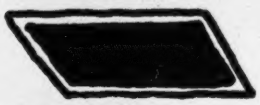
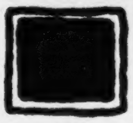
Sub category	Description	Frequency
1. Oval, elliptical		29
2. Free form, symmetrical		18
3. Rectangular		15
4. Rectangular, trimmed corners		15
5. Round		13
6. Six sides		8
7. Eight sides		8
8. Free form, no symmetry		8
9. Diamond		4
10. Resembles an object		3
11. Rectangular with rounded corners on one end		3
12. Five sides		2
13. Parallelogram		1
14. Square		1

Table 2

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 2: Side Contour of Product

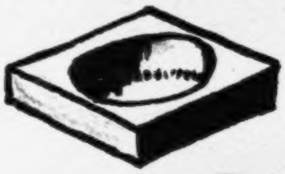
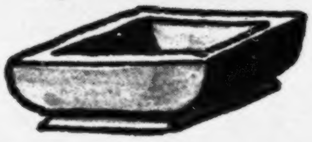
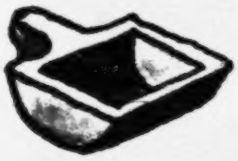
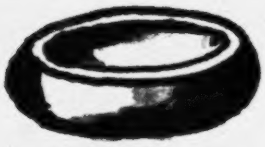
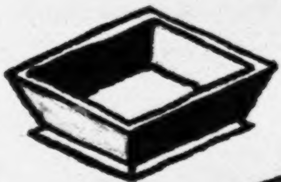
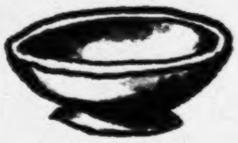
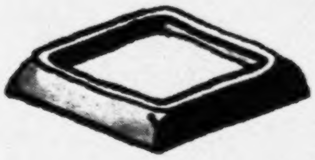
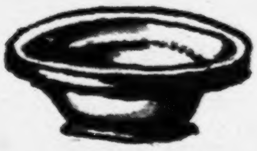
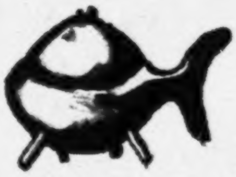
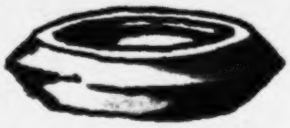
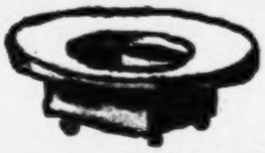
Sub-category	Description	Frequency
1. Vertical, straight		68
2. Vertical and receding		22
3. Side contour changes		13
4. Curved inward, top and bottom		7
5. Receding, straight		5
6. Receding, curved		4
7. Vertical, rounded at top		3
8. Step contour		2
9. Side contour takes shape of an object		2
10. Sharp projecting center		1
11. Projecting lip, then vertical		1

Table 3

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 3: Thickness of Lip (plane view)

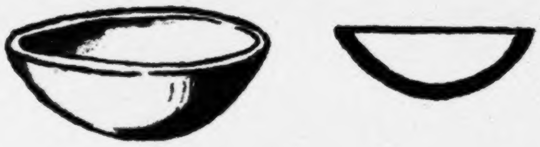
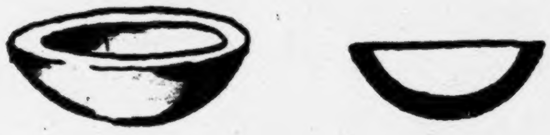
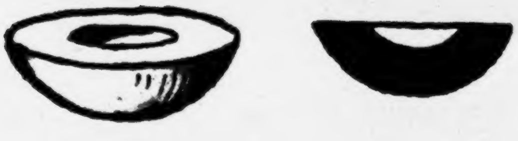
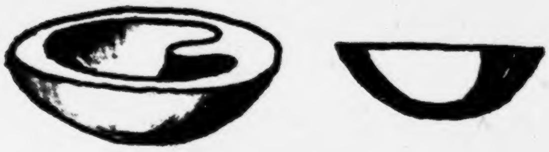
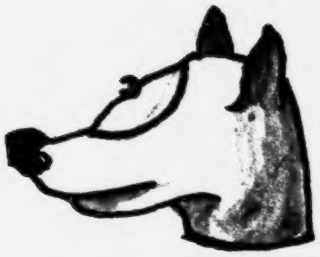
Sub-category	Description	Frequency
1. Thin		39
2. Medium		34
3. Thick		32
4. Variation in thickness of lip		17
5. Container of such a nature that consistent lip thickness cannot be determined		6

Table 4

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 4: Support

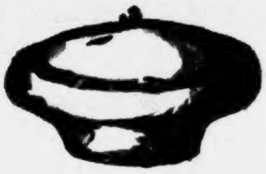
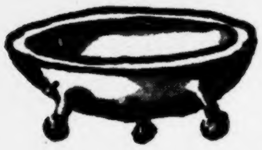
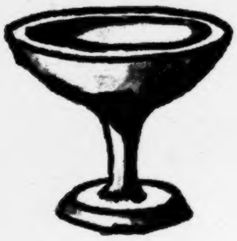
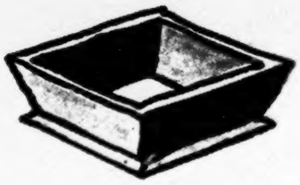
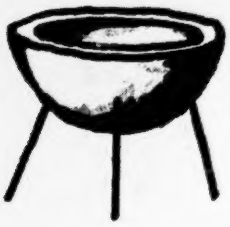
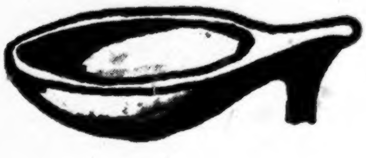
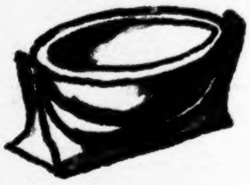
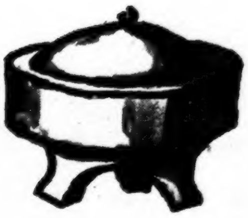
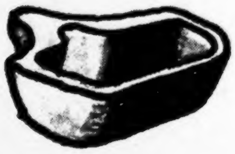
Sub-category	Description	Frequency
1. No legs or base		84
2. Short feet		11
3. Center pedestal		8
4. Flat base, one piece		4
5. Spindle legs		3
6. Bottom plus leg support		3
7. Bowl "swings" on base		3
8. Feet carved out of bowl, not attached		2
9. "Tipping" base		2

Table 4, Continued

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 4: Support

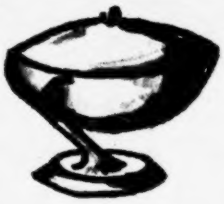
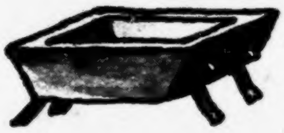
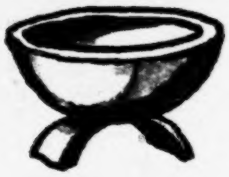
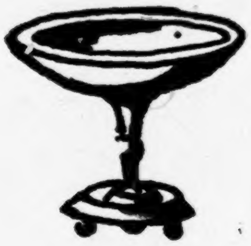
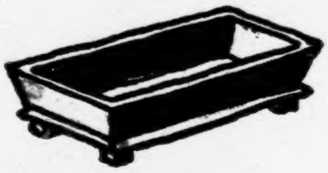
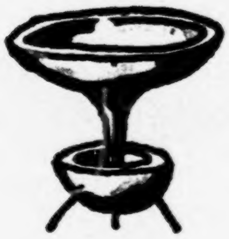
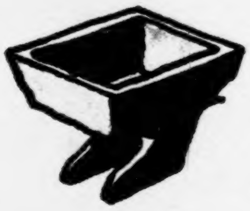
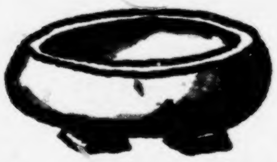
Sub-category	Description	Frequency
10. Off-center pedestal		1
11. Legs attached to bowl side		1
12. Arc support		1
13. Pedestal plus feet		1
14. Flat base with feet attached		1
15. Bowl contained in pedestal base		1
16. "Ski" base		1
17. Flat base, two piece		1

Table 5

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 5: Ornamentation

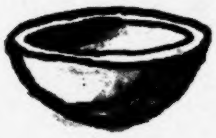
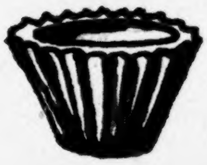
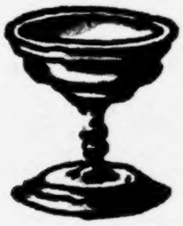
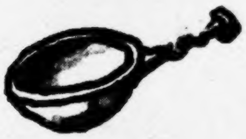
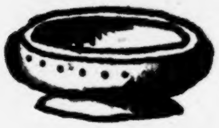
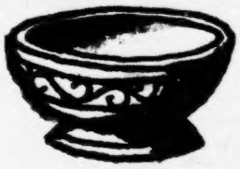
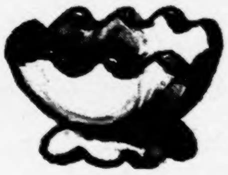
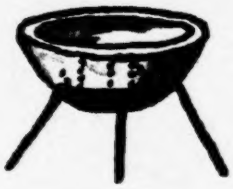
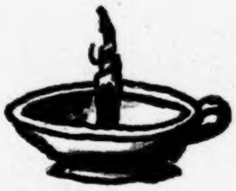
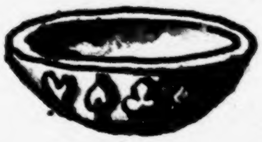
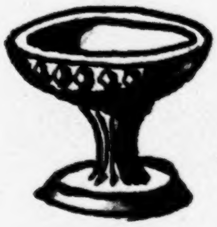
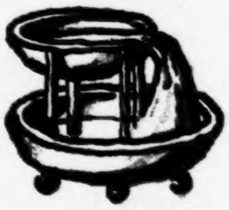
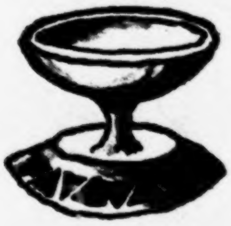
Sub-category	Description	Frequency
1. No ornamentation		99
2. Grooves, flutes		11
3. Simulated wood turning, bowls, handles, pedestals	 	4
4. Decorative depressions		3
5. Veining		3
6. Scallops		2
7. Decoration with pins		1
8. Candle in center		1
9. Decorative overlays		1
10. Flutes plus overlays		1
11. Waterfalls		1
12. Geometric decoration cut out of base		1

Table 6

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 6: Lifting Devices, Covers

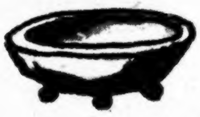
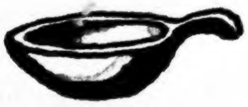
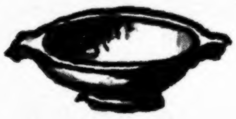
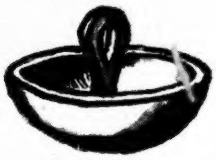
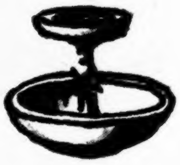
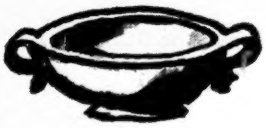
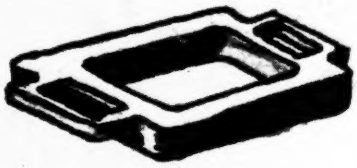
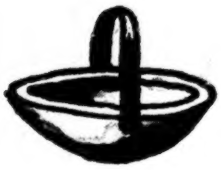
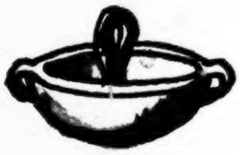
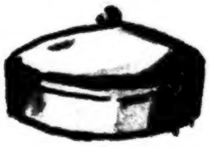
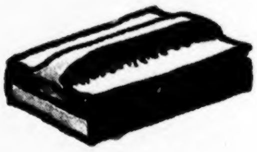
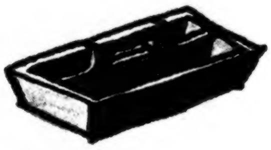
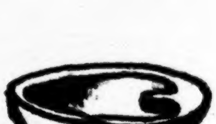
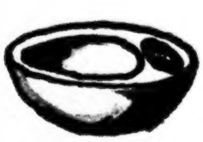
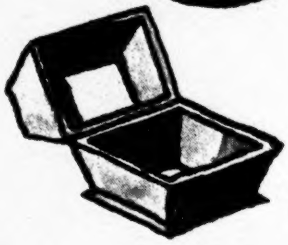
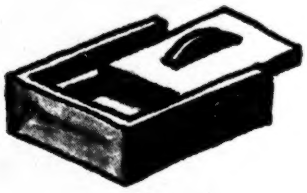
Sub-category	Description	Frequency
1. No lifting devices or covers		71
2. One handle on the side		16
3. One finger lift on each side, no finger grips		7
4. Vertical handle, center		7
5. Upper tray designed as a lifting handle		5
6. One finger lift on each side, finger grips		4
7. "Cut out" handle, both ends		4
8. "Bucket" type of handle		3
9. Vertical handle plus side handles		2
10. "Lifting" cover with handle		2
11. "Lifting" cover, no handle		2
12. Divider also serves as a handle		1
13. Bowl "folds" to become handle		1
14. Finger hole		1
15. Hinged cover		1
16. Sliding cover with handle		1

Table 7

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 7: Relationship of Inside to
Outside Contour

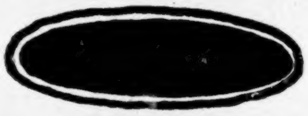
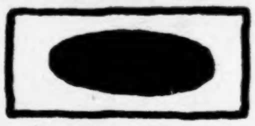
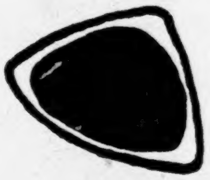
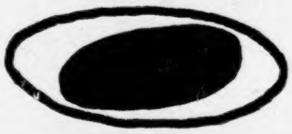
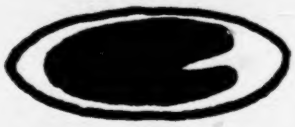
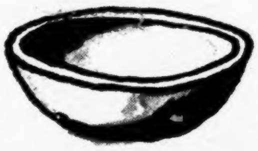
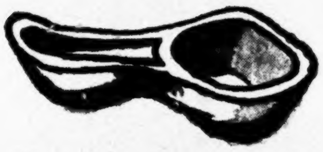
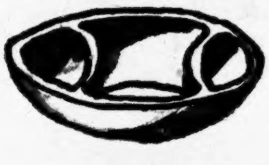
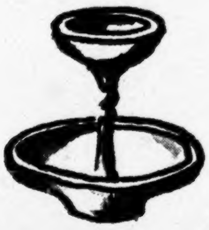
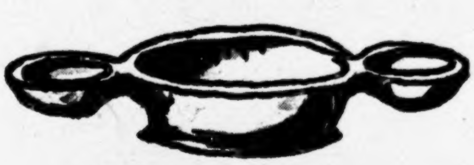
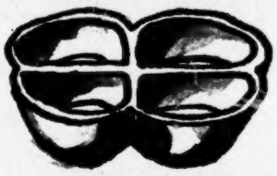
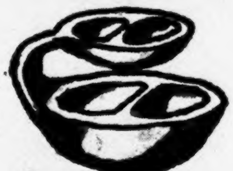
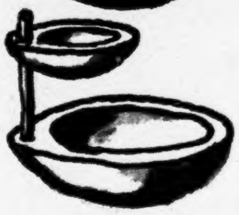
Sub-category	Description	Frequency
1. Inside shape of container completely follows shape of outside contour		90
2. Different shape on inside than outside		19
3. Inside follows outside basically, but thickness increases at sharp contours		7
4. Follows basic shape, but thickness-thinness follow a symmetry pattern		6
5. Inside roughly follows outside but no pattern variation		6

Table 8

SYMBOLIC UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 8: Divisions, Trays, Units

Sub-category	Description	Frequency
1. No divisions, extra units, trays or containers		93
2. One container, two compartments		17
3. One container, three compartments		5
4. One extra, separate container, attached above, below or alongside		5
5. Two extra, separate containers, attached above, below or alongside		3
6. One container, four compartments		3
7. One or more extra containers plus divisions within containers		1
8. Extra tray slides up and down on a vertical support		1

assumption was made that certain of the differentiating characteristics comprising the design and structure of the product also influenced the degree and nature of unusualness inherent in the product. For example, was the addition of a handle as important in the final determination of a scale for unusualness as was the basic shape (plane view) or the shape of the side contour? In order to arrive at a decision concerning the weighting factor, a panel of five experts from the fields of design, art education, and industrial education, all of whom possessed experience in the design and construction of decorative bowls, trays, etc., were asked to assign weights of one to four to the eight categories. An estimate of the inter-rater reliability of the assigned scores was obtained by using an analysis of variance technique.[87] The resulting coefficient of .93 indicated satisfactory inter-rater agreement on the assignment of weights to categories of symbolic unusualness. An average of these weights assigned by five panel members was the final weight designated to each of the eight main categories.

Table 9 presents the frequencies, category weighted scores (frequency times category weight), total weighted scores and coded scores (one through seven, based upon a forced normal distribution of total weighted scores), for symbolic unusualness of a sample of ten products (Nos. R1 to R10). An identical scoring procedure was used for all 128 products in the total sample.

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[87] $$r = \frac{\text{MS rows} - \text{MS residual}}{\text{MS rows}}$$

Table 9

COMPUTATION OF TOTAL SYMBOLIC UNUSUALNESS SCORES FOR PRODUCTS R1 TO R10

Product No.	Differentiating Characteristics																Total Weighted Score	Code
	1		2		3		4		5		6		7		8			
	Plane view Wgt. 4		Side contour Wgt. 3.6		Thickness of lip Wgt. 3.2		Support Wgt. 1.8		Ornamentation Wgt. 1.4		Lifting devices Wgt. 1.6		Relation of inside to outside Wgt. 1.4		Divisions trays Wgt. 2.4			
	Reg. score	Weighted	Reg. score	Weighted	Reg. score	Weighted	Reg. score	Weighted	Reg. score	Weighted	Reg. score	Weighted	Reg. score	Weighted	Reg. score	Weighted		
R1	18	72	68	245	32	102	11	20	99	138	71	114	90	216	5	12	919	4
R2	13	52	68	245	39	125	11	20	99	138	71	114	90	216	17	41	951	4
R3	13	52	22	79	39	125	84	151	11	15	7	11	90	216	93	223	812	5
R4	18	72	13	47	39	125	11	20	99	138	71	114	90	216	93	223	955	4
R5	18	72	68	245	39	125	84	151	11	15	71	114	6	14	17	41	777	4
R6	29	116	22	79	39	125	8	14	4	6	4	6	90	216	3	7	569	7
R7	29	116	22	79	39	125	11	20	99	138	71	114	90	216	93	223	1031	3
R8	29	116	22	79	39	125	3	5	99	138	16	26	90	216	93	223	928	4
R9	8	32	22	79	39	125	3	5	99	138	16	26	90	216	93	223	844	5
R10	29	116	68	245	32	102	84	151	11	15	7	11	6	14	1	2	656	6

Table 10 shows the percentages of the products, the number of products, and the code assigned to each of the seven scoring intervals used in the study.[88] By using an arbitrary standard deviation of .6, it was possible to include over 98 percent of the area under the normal curve. The percentage of the total sample of 128 which fell into each of the seven intervals was determined by referring to a standard table. In assigning the code score, the range of total weighted scores was inverted so that higher frequency scores received lower coded scores, and vice versa.

Table 10

PERCENTAGES OF THE TOTAL GROUP, NUMBER OF PRODUCTS AND CODES ASSIGNED TO EACH OF SEVEN CATEGORIES

N = 128 S.D. = .6*

Z	Percent of total	Total N in each category	Code assigned	
Above 1.50	7%	9	7	Most unusual
.90 to 1.50	11%	14	6	
.30 to .90	20%	25	5	
- .30 to +.30	24%	32	4	
- .90 to -.30	20%	25	3	
-1.50 to -.90	11%	14	2	
Below -1.50	7%	9	1	Least unusual
Total	100%	Total 128		

* (.6 S.D.) x (7 categories) = 4.2 S.D. = .9821 (area under normal curve)

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[88] Method described in H. M. Walker and J. Lev, *Elementary Statistical Methods*, (New York, N. Y.: Henry Holt and Co., 1958), 191-193.

Evaluation of symbolic usefulness. Moss,[89] in elaborating on his general definition of creativity, stressed a need for considering the usefulness of a product as well as its unusualness. Of this he states:

> While some degree of unusualness is a necessary requirement for creative products, it is not a sufficient condition. To be creative, an industrial arts student's products must satisfy the minimal requirements of the problem situation; to some degree it must "work" or be potentially "workable". Completely ineffective, irrelevant solutions to teacher imposed or student initiated problems are not creative.

The necessity for developing a scale of symbolic usefulness was thus made apparent. According to the definition of symbolic creativity, such a definition should take into account two factors. First, a useful product must be capable of functioning as a container for the purpose specified (holding nuts or fruit). Second, beyond that requirement, usefulness must be measured in terms of the product's aesthetic appearance. A product considered to be useful was one which expressed an aesthetic quality which was gratifying to the taste, and would be sought out by those individuals who had developed a sensitivity to beauty and design. A "useful" object then, serves in a useful decorative capacity; its usefulness is evidenced by its minimum ability to serve as a container and the relative degree of decorative appeal which it evokes.

All products offered by the sample were evaluated by two teams of two judges each, who considered (1) workability and (2) aesthetic beauty. Judges selected were from the fields of design and industrial arts education and were familiar with the design and construction of decorative bowls and trays. Judges had from four to eleven years of teaching experience and all held the Master's degree. They were selected from a group of nine judges who originally participated in the pilot study conducted at University of Minnesota High School.

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[89] J. Moss, Jr., op. cit. (see Appendix B).

The two teams of judges, utilizing a Q-sort technique, classified the products into seven categories from the least useful (aesthetically appealing) to the most useful. A normal distribution of scores was established by specifying the number of products to receive each score, applying the same method as was used for coding unusualness scores.[90] The final symbolic usefulness score assigned to each product was an average of the ratings assigned by the two judging teams.

An estimate of the inter-rater agreement between the scores assigned by the two judging teams, computed by using an analysis of variance technique,[91] revealed a reliability coefficient of .78.

Table 11, which presents the team ratings for usefulness and averaged scores for products R1 to R10, illustrates the technique used for this part of the evaluation.

Measurement of Figural Unusualness and Usefulness, Approach B

Considerations. The measurement of figural creative content presented the problem of how to best evaluate a student's creative abilities as applied to problems involving the manipulation of

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[90] Described on p. 69.

[91] $$r = \frac{(\text{MS rows}) - (\text{MS residual})}{\text{MS rows}}$$

Table 11

COMPUTATION OF TOTAL SYMBOLIC USEFULNESS SCORES FOR PRODUCTS R1 TO R10

Product number	Team 1 rating	Team 2 rating	Average
R1	3	3	3.0
R2	2	1	1.5
R3	7	6	6.5
R4	4	3	3.5
R5	5	3	4.0
R6	6	6	6.0
R7	4	6	5.0
R8	4	6	5.0
R9	5	3	4.0
R10	5	4	4.5

real inanimate objects, tools and processes. Figural creativity in industrial arts is typically concerned with the relationships among component parts and how these may be arranged or combined in a manner which makes them most useful for a given task. In industrial arts classes, students are taught to plan ahead regarding tool sequences, operations and material usage. The element of creative thinking which accompanies such actions is therefore an important consideration.

An approach similar to the system used for the measurement of symbolic creativity was utilized for the evaluation of figural creative content.

First thoughts on the selection of a problem which encouraged figural creativity centered about the design and construction of implements of an unusual nature. For example, a tool which could be used by a two fingered man from Mars, or an eating utensil which would take the place of a knife, fork and spoon, etc. It was reasoned, however, that the use of such "science fiction" types of products would probably produce a very small range of scores; there would be a few creative ideas and a majority of much less creative ideas. It was concluded that a broader range of scores would be forthcoming if a product were selected which was very common to all eighth grade boys, but which was complex enough to stimulate new and unusual ways of design and construction.

The test. Each student was given a 2" x 6" x 8" piece of styrofoam and a kit containing the same group of tools and materials utilized in the symbolic creativity test approach. Instructions given to the group were also similar, except that this time students were asked to construct one combination tool which could be used to tighten nuts on a bicycle and open pop bottles. Instead of encouraging artistic beauty, as was done for the symbolic test, instructions were given to "use your mechanical ingenuity in designing a tool which is unusual as well as useful for the job intended." A fifty minute period was allowed for the completion of the product.

Evaluation of figural unusualness. The same basic system of evaluation was employed for figural as was used for symbolic unusualness, the main difference was the type and quantity of differentiating characteristics delineated for rating purposes.

A panel of six experts, including one graduate engineer and five industrial education teachers (one of whom had an engineering background), were asked to describe the major differentiating features which would characterize a tool of the sort used in the evaluation. Those differentiating characteristics thought capable of identifying figural unusualness were as follows:

1. Function in use (wrench)
2. Function in use (opener)
3. Pieces in total construction
4. Folding or swivel action
5. Reinforcement
6. Handle shape
7. Accessability
8. Removable parts
9. Leverage
10. Offset to provide clearance
11. Storage
12. Hand protection
13. Manner of joining parts
14. Other features

Using the same system that was developed for symbolic unusualness, all products were examined and evaluated by the investigator with respect to each of the fourteen major differentiating characteristics suggested by the panel. Sub-categories descriptive of distinctions found within each of the fourteen major categories were developed. Scores were based on the frequency with which products were classified in each sub-category of all fourteen major categories.

Tables 12 to 25 contain the frequency data found in the fourteen major categories. Although more major categories (fourteen) were found to be necessary to assess unusualness for this product than for the symbolic product, a considerably smaller number of sub-categories was found to be applicable within each of the main categories. The overall effect of number and placement of categories and sub-categories was that there was approximately the

Table 12

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 1: Function in Use

Sub category	Frequency
1. Fits only one size of nut	73
2. Threaded adjustment for different sizes	25
3. Fits two sizes of nuts	12
4. Fits three sizes of nuts	6
5. Fits four sizes of nuts	5
6. Fits more than four sizes of nuts	3
7. Fits more than one kind of nut	3
8. Metal strips are "sprung" into position around nut to provide adjustment	1
9. Wrench not completed*	1

*Award 129 points

Table 13

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 2: Function in Use (Opener)

Sub category	Frequency
1. No extra function; ordinary "lift" type opener	108
2. More than one bottle opener on the same tool (same type)	4
3. "Flip out" opener in handle of tool or case	4
4. "lever" type depresser to open bottles	3
5. More than one type of opener on same tool	2
6. Addition of a cork screw	1
7. Stationary opener; tilt bottle in opener (like dispensing machines)	1
8. Bottle opener incomplete*	6

*Award 129 points

Table 14

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 3: Pieces in Total Construction

Sub category	Frequency
1. One piece	51
2. Two pieces	32
3. Three pieces	28
4. Four pieces	9
5. Five pieces	3
6. Eight pieces	2
7. Nine pieces	2
8. Seven pieces	1
9. Ten pieces or more	1

Table 15

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 4: Folding or Swivel Action

Sub category	Frequency
1. Non-swivel	107
2. One swivel, use of pins	11
3. Two swivels, use of pins	5
4. Constructed own swivel mechanism instead of using pins	5
5. Three swivels or more	1

Table 16

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 5: Reinforcement

Sub category	Frequency
1. No reinforcement	117
2. Reinforced wrench and opener	6
3. Reinforced wrench	4
4. Reinforced opener	2

Table 17

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 6: Handle Shape

Sub category	Frequency
1. Does not fit hand, sharp edges, thick (over ½")	59
2. Has sharp edges but thin (½" and under)	33
3. Rounded or shaped handle, thick	18
4. Rounded or shaped handle, thin	6
5. Does not have conventional handle	6
6. Finger grips, fits hand	3
7. Handles of different sizes and shapes to fit on one tool	2
8. "Faucet" type handle with finger grips	1
9. Handle shaped like an object, fish, bird, etc.	1

Table 18

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 7: Accessibility

Sub category	Frequency
1. No provisions for working in tight places	115
2. Vertical handle, attachment, or swivel device for working in tight corners	11
3. Vertical handle, tool is a separate part of the set	2
4. Vertical handle plus extra sockets to fit handle	1

Table 19

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 8: Removable parts

Sub category	Frequency
1. One unit	123
2. Wrench units can be "snapped" on the handle	4
3. Wrench and bottle opener units snap together	1
4. Removable saw and opener attached to handle	1

Table 20

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 9: Leverage

Sub category	Frequency
1. No additional leverage (handle 8" or under)	112
2. "Case" for tool swivels to become handle extension	6
3. Bottle opener swivels out and can be tightened on wrench to double leverage	6
4. Handle made longer than the length of the styrofoam	5

Table 21

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 10: Offset (To provide clearance)

Sub category	Frequency
1. No offset	124
2. Wrench set at an angle to the handle, or handle curved to provide offset	5

Table 22

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 11: Storage

Sub category	Frequency
1. No provisions for storage	113
2. Hole for hanging up	7
3. Tool "folds" into case like a jack knife	5
4. Separate case or rack for tool is included	2
5. Small storage compartment for sockets or small parts	2

Table 23

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 12: Hand Protection

Sub category	Frequency
1. No hand protection	125
2. Hand protection provided by clearance (raised handle)	2
3. Special "hand grasp" provided at the top of the tool	1
4. Handle set at slight angle	1

Table 24

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 13: Manner of Joining Parts

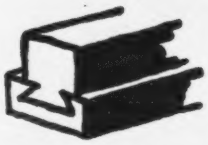
Sub category		Frequency
1. No joining required (one piece)		71
2. Flush joining only.		42
3. Keyed joining.		9
4. Use of machine pins.		6
5. Insertion of keys in keyways.		1

Table 25

FIGURAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
Category No. 14: Other Features

Sub category	Frequency
1. No extra features	114
2. Screw driver included.	7
3. Addition of ordinary type can opener.	3
4. Addition of coke bottle and coke machine.	2
5. Pliers and saw included.	1
6. Addition of plane, screwdriver and window scraper.	1
7. Addition of knife.	1

same opportunity to display unusualness in the wrench-bottle opener product as in the fruit and nut bowl product used for the evaluation of symbolic creativity.

As in the symbolic unusualness evaluation, products tended to be influenced by the original shape of the styrofoam material. In only six out of 129 cases was additional wrench leverage obtained by adding to the original length of the material (See Table 20). Offset to provide clearance was found in only five products; most students visualized the tool as perfectly flat like the shape of the original material (See Table 21).

Following the assignment of frequency ratings to the products, an attempt was made to determine weights for the fourteen categories representing the major differentiating characteristics. The same panel which originally selected these characteristics could not reach any satisfactory agreement with respect to the weights; four voiced the opinion that the categories should not be weighted differently, and the weights assigned by the remaining two panel members were completely lacking in agreement. On the basis of a lack of accord, the decision was made to weight all fourteen factors equally.

Table 26 presents the frequencies for each sub-category, the total frequency scores, and the normalized coded scores for figural unusualness for products R1 to R10. All 129 products were rated in the same manner. The coded scores, numbered from one to seven, were based upon a forced normal distribution with pre-assigned numbers of products in each of the seven categories.

Table 26

COMPUTATION OF TOTAL FIGURAL UNUSUALNESS SCORES FOR PRODUCTS R1 TO R10

Product No.	Differentiating Characteristics														Total	Code
	Category 1	Category 2	Category 3	Category 4	Category 5	Category 6	Category 7	Category 8	Category 9	Category 10	Category 11	Category 12	Category 13	Category 14		
R1	12	108	9	11	6	33	11	4	112	124	113	2	42	114	701	7
R2	73	108	51	107	117	59	115	123	112	124	113	125	71	114	1412	1
R3	25	108	28	107	117	33	115	123	112	124	113	125	7	114	1251	4
R4	73	129	51	107	117	59	115	123	112	124	113	125	71	114	1433	1
R5	12	108	32	107	117	1	115	123	112	124	7	125	42	114	1139	5
R6	73	108	28	5	117	6	11	123	6	124	113	125	71	114	916	7
R7	25	108	28	107	117	18	115	123	112	124	113	125	42	114	1271	4
R8	73	108	9	107	117	59	115	123	112	124	113	125	71	114	1370	3
R9	25	108	8	107	117	6	115	123	112	124	113	125	9	114	1207	5
R10	25	108	32	107	117	59	115	123	112	124	113	125	42	114	1240	4

Evaluation of figural usefulness. Figural usefulness was defined in terms of the ability of the product to function as a (1) bicycle wrench and (2) bottle opener. Products were rated by the same two teams of judges, utilizing the same procedure used for the evaluation of symbolic unusualness. An average of the two-team ratings was the final score awarded to each product. A computation of the inter-rater reliability of the two team ratings produced a reliability coefficient of .85.[92] Table 27 presents the team ratings for figural usefulness and averaged scores for products R1 to R10. Scores for all other products were gained in the same manner.

Table 27

COMPUTATION OF TOTAL FIGURAL USEFULNESS SCORES
FOR PRODUCTS R1 TO R10

Product No.	Team 1 Rating	Team 2 Rating	Average
R1	4	3	3.5
R2	4	6	5.0
R3	6	7	6.5
R4	1	1	1.0
R5	1	1	1.0
R6	5	4	4.5
R7	5	6	5.5
R8	4	4	4.0
R9	7	6	6.5
R10	7	6	6.5

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[92] $r = \frac{(\text{MS rows}) - (\text{MS residual})}{\text{MS rows}}$

Measurement of Behavioral Unusualness and Usefulness, Approach B

Considerations. Behavioral creativity is exhibited primarily in those situations in which human relationships are involved. Interactions among pupils and between pupil and teacher may provide situations through which students can express creative thought and action. Despite the obvious fact that behavioral creativity may find opportunity for expression in virtually all fields and places of endeavor, the industrial arts laboratory provides the type of atmosphere in which it is quite likely to occur. It was therefore decided to seek an evaluation of behavioral creativity by utilizing behavioral problem situations which were typical of the industrial arts laboratory.

The test. An instrument was developed in which students were asked to respond to six situational industrial arts oriented problems involving human relationships by suggesting creative, yet effective ways of handling the problems. (See Appendix D). Students were informed that there were no correct or incorrect solutions to the problems, but because there could be several possible solutions, imagination should be used to think of the one best way of handling the situation presented. Subjects were also urged to devise a unique manner of handling each problem, a way which had never been conceived of before. A fifty minute period was allotted for completion of the six problem solutions. Subjects completing the task earlier were requested to spend the remainder of the period seeking to improve their original solutions.

Evaluation of behavioral unusualness. As was the case for both symbolic and figural unusualness, subjects provided a range of solutions which could easily be categorized and later scored on the basis of frequency of occurrence. For each of the six problems presented, solutions offered by the subjects were analyzed and fitted into pre-arranged categories of solutions based upon the findings of the original pilot study. The number of subjects from the total group of 129 who proposed each type of solution was then tabulated. Ratings were assigned on the basis of the frequency of occurrence of problem solutions; those solutions which were less frequent received higher final scores than those which were observed more frequently.

Tables 28 to 33 present the categories of solutions for each of the six problems and the frequency of occurrence of solutions in each category. Under each of the category headings are brief descriptive statements of the responses offered by subjects who chose those categories to represent a best possible problem solution. In eight cases out of a total of 774 responses, where answers were illegible or no response was offered, the frequency score of 129 was assigned, thus giving the respondent the lowest score attainable for behavioral unusualness.

An equal number of categories was not developed for each of the six problems. The procedure for selecting categories was a subjective one based upon the decisions of the same panel of experts who had developed categories for symbolic and figural unusualness. The panel delineated categories so that, in their estimation (1) the potential variance of scores between the products was not

Table 28

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 1

You are making a letter opener which you designed yourself. After seeing your design, two other boys decide to make identical projects. This disturbs you because you would like to take the credit for thinking of this idea when projects are displayed at open house. What would you do?

No.	Solution	Frequency
1(a)	Modification of present design (a) Compromise by changing the design a bit. (b) Add something to mine. (c) Make my design more elaborate. (d) Change the shape, add some extra ornamentation.	29
1(b)	Credit given, No. 1 (a) Ask that copiers consent to giving me credit for designing. (b) Put a sign on the project saying "originator." (c) Put original drawing and a note explaining about project, in the show window. (d) Sign saying "Made by Joe Smith, copied by Bill Jones and Ed Brown."	17
1(c)	Reasoning, begging, pleading (a) Ask others not to copy. (b) Ask them to modify their designs to make something different. (c) Point out that their parents will be happier if they design their own. (d) Explain that they can have more pride in their work if they don't copy.	12
1(d)	Make a completely new design (a) Make another design which is better than theirs. (b) Design a project which no one else will think of; keep in teacher's drawer. (c) Make a better design which would be more difficult to construct and copy.	11

Table 28 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 1

No.	Solution	Frequency
1(e)	Same project, better workmanship (a) Make mine better. (b) Make the project anyway, teacher will choose the best one for display. (c) I would make mine so good that the others wouldn't stand a chance.	9
1(f)	Teacher responsibility (a) Tell the teacher that mine is the original one. Let him decide how to handle it. (b) Teacher knows that you turned in the original plan sheet. (c) Ask teacher that you be given credit. (d) Discuss with teacher.	7
1(g)	Passiveness (a) Not be concerned. (b) Let it ride; it will get on his conscience. (c) I wouldn't care, copiers would know that they copied mine. (d) Nothing. I would pride myself in having such a good design that others would want to copy it.	7
1(h)	Early completion (a) Turn in my project before others complete theirs; explain to teacher why.	5
1(i)	Assist the copiers (a) Help copiers plan another project. They copy because they need help in planning. (b) Suggest other plans for them. (c) Let them see some of my other good designs. (d) Help them pick out something different.	5

Table 28 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE PROBLEM NO. 1

No.	Solution	Frequency
1(j)	Trickery #1 (a) Put artificial pieces on by gluing or simply fitting them on. This is to make other boys think that the added parts are part of the original idea. (b) Add removable parts until just before open house. (c) Pretend to add something; meanwhile be making a better one which they don't know about.	4
1(k)	Changing the drawing secretly (a) Change my drawing (which they are copying) to make it look funny. Then secretly make project the right way from another drawing. (b) Make secret changes in plans. (c) Lay first design in an obvious place where they will see it, then make it different. (d) Keep altering my design, confuse them.	4
1(l)	To demand, order (a) Tell others to design their own projects. (b) Tell them off. (c) Tell them that they better "shape up".	3
1(m)	Concealment of project (a) Cover up your project so that others can't see what you are making. (b) Do most of the work outside the shop, and then keep in locker.	3
1(n)	Acquire a "patent" (a) Have teacher put "like a patent" on it. (b) Get a copyright.	3
1(o)	Belligerence (a) Get rough with them. (b) "Bust" his project.	3

Table 28 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 1

No.	Solution	Frequency
1(p)	Modification by both parties (a) Ask the others to modify their project and I will also change my own.	2
1(q)	Credit given, No. 2 (a) Attach a note to the project giving starting and finishing dates.	2
1(r)	Make an extra project (a) Complete that project,--and if I'm that good at designing, I might have time to do another one. I'd then have two projects for open house.	1
1(s)	Adding a feature which cannot be copied. (a) After they have copied it and turned their's in, I would carve my name in the handle.	1
1(t)	Trickery #2 (a) Convince them that the teacher will not accept a copied design.	1

Table 29

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 2

As a cleanup assignment, it is your job to check that students put tools away. One boy always leaves his tools on the work bench. You are becoming tired of telling him to take care of his own tools and your teacher is so busy at cleanup time that you don't wish to bother him with your problem. How could you handle this situation yourself?

No.	Solution	Frequency
2(a)	Ignore situation (a) Simply leave the tools;--if teacher asks tell him the problem. (b) Don't tell him, this is not my problem but his.	19
2(b)	Teacher responsibility, No. 1 (a) Get teacher to make him do it. (b) Discuss matter with teacher. (c) Tell teacher when he is not busy. (d) Ask teacher to provide a penalty. (e) Leave note on the teacher's desk. (f) Ask teacher to change jobs for everyone.	14
2(c)	To demand, order, insist (a) Insist that he put them away. (b) Keep reminding him. Nagging will wear him down. (c) Tell him to get started on time. (d) Tell him to put them away.	13
2(d)	Passiveness (a) Shame the boy into putting away his tools by doing it for him for a while. (b) It's really no extra trouble if everyone else puts their tools away. (c) I would put them away (no reasoning). (d) Put them away and tell teacher	11
2(e)	Penalty No. 1 Forbid use of tools until he puts them away on time (either teacher or cleanup foreman authority).	11

Table 29 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 2

No.	Solution	Frequency
2(f)	Retaliation No. 1 (a) Have him take your job for a while and do the same thing with him. (b) Trade jobs with him (ask shop foreman). (c) Mess up his clean-up assignment.	10
2(g)	Reasoning, begging, pleading (a) Reason with the boy. Try to have him see the error of his way. (b) Point out that his grade will be effected. (c) Point out that he may be late for the next class. (d) Have a talk with the boy. (e) Explain that sloppy habits will hinder his chances when he applied for a job.	8
2(h)	Taper off assistance (a) Help him put away things at first, and gradually diminish help. (b) Do it yourself for two or three times. (c) Do it yourself just once and warn him.	7
2(i)	Penalty No. 2 (a) Penalize him by making him put all tools in the shop away. (b) Make him do someone else's clean up job also. (c) Add more work to his clean up job. (d) Make his job harder for him.	7
2(j)	Threatening (a) Threaten to tell teacher. (b) Tell him he will be in real trouble with me. (c) Threaten to tell teacher, but don't really.	6
2(k)	Assigning help (a) Assign someone else to do the job. If teacher asks why, tell him. (b) Appoint someone to watch him and get him going on time.	3

Table 29 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 2

No.	Solution	Frequency
2(l)	Early clean-up Have him clean up five minutes earlier than the others.	2
2(m)	Penalty No. 3 Have him return each tool before he is issued another.	2
2(n)	Retaliation, No. 2 (a) Pull a prank on him. (b) Get there early, put a lot of tools on his bench. Teacher will wonder how they got there.	2
2(o)	Belligerence When class is over, get him out in the hall.	1
2(p)	Teacher responsibility, No. 2 (a) The teacher will see this if it happens often. (Student accepts no responsibility for informing teacher.)	1
2(q)	Provide reminders Tie a string around his finger so he will remember.	1
2(r)	Kindness Be his friend by helping him. A boy like that probably needs friends. This will snap him out of it.	1
2(s)	"Kidding" Kid him about the fact that he can't put his tools away and even a baby can do that.	1

Table 29 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 2

No.	Solution	Frequency
2(t)	Penalty No. 4 Make him pay for all missing tools.	1
2(u)	Penalty No. 5 One minute after school for every tool left out.	1
2(v)	Penalty No. 6 At the beginning of the next class period, ask the teacher to appoint a student to help put away tools, because it is such a big job. Suggest this boy for the job.	1
2(w)	Retaliation, No. 3 "Get even" by not allowing him to use the drill press (keep machine all period).	1
2(x)	Retaliation No. 4 Disassemble his tools.	1
2(y)	Incentive program Ask teacher to initiate a program where prizes are offered for neatness and good management.	1
2(z)	Personal tool rack Make a tool holder for him and place it at his bench.	1
2(aa)	Apply group pressure Put the pressure of the whole class on him by telling students that tool use will be limited if he doesn't put tools away.	1
2(bb)	No response or illegible (award 129 points)	1

Table 30

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 3

Your class has been given the assignment of making a wall shelf. Because this same type of shelf is being made by six people in the class, it is difficult to distinguish your shelf parts from those of the other students. There are no lockers in the shop so all project parts are stored on an open shelf. The next day you discover that the pieces which you cut out are gone and in their place are similar pieces which are very crudely done. You strongly suspect that another boy has traded his poorly done work for your nicely done shelf parts but you can't prove this. How would you handle this situation?

No.	Solution	Frequency
3(a)	Better identification in the first place. (a) Put tape on them in advance (for marking). (b) Put parts in a container. (c) Burn my name on the back. (d) Write name on all parts. (e) Make shelf parts out of a different kind of wood so they can be identified.	25
3(b)	Teacher responsibility (a) Tell teacher, ask him how to identify which work is mine or the other boys. (b) Find my pieces, then consult teacher. (c) This is a problem for the teacher. (d) Bring all clues and supporting evidence to the teacher.	14
3(c)	Passiveness, No. 1 (a) Fix up crudely done pieces. (b) Try to "get by" with pieces that I have. (c) Find a way to make parts into nice projects. (d) Turn his work into good work.	13
3(d)	Trade parts secretly (a) Switch back the next day and put the parts in my street locker. (b) Switch back, put secret identifying marks on them and see if I could catch him next time. (c) Switch back and then take my parts home every day for a few days.	13

Table 30 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 3

No.	Solution	Frequency
3(e)	Belligerence (a) "Persuade" him after school. (b) Beat him up. (c) Fight with him. (d) Find out for sure, then take it away from him by force. (e) Ask first, then hit him.	11
3(f)	Reasoning, begging, pleading (a) Reason with boy, point out the error of his way. (b) Point out that he may have picked up the wrong parts accidentally. (c) Explain to the boy that the teacher will be able to recognize the quality of work.	10
3(g)	Identifying marks (a) Look for distinguishing marks on my pieces. (b) Identify my parts by certain details and markings.	9
3(h)	Make new pieces (a) Start over, make certain that pieces are identified this time. Tell teacher what happened so that he knows why you are behind. (b) Start over, make a better one.	8
3(i)	Workmanship as evidence (a) Point out to teacher that his other parts are probably crudely done also. This will be evidence of which are mine. (b) Teacher will have suspicions when he sees good quality work in the hands of a poor student.	5
3(j)	Student evidence (a) Ask other students for supporting evidence.	5

Table 30 (continued)
BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 3

No.	Solution	Frequency
3(k)	Passiveness, No. 2 (a) Don't mention it, boy will have a guilty conscience, that is his punishment. (b) Be nice about it, toss a coin.	3
3(l)	Threatening (a) Threaten to tell the teacher, but really don't. This might cause him to tell the truth.	3
3(m)	Permission to check parts (a) Ask to check other student's projects. The person who refuses to let you check his parts is the guilty one.	1
3(n)	Retaliation No. 1 (a) After school, write your name (in ink) on your pieces that the boy claimed. Then report him to the teacher.	1
3(o)	Retaliation No. 2 (a) Make up shelf parts a little off size and slip them on his shelf. None of his parts will fit together.	1
3(p)	Encourage a voluntary trade (a) Fix up the crude pieces so well that the boy will want them back.	1
3(q)	Performance test as evidence (a) Have him work a piece of wood to provide evidence of his workmanship. If crude, then the parts are mine.	1
3(r)	Working time as evidence (a) Ask others who are making the same project, how long that it took them. Next, check with this boy and find out how long it took him. If there is a discrepancy, he is lying.	1
3(s)	No response or illegible (Award 129 points)	1

Table 31

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 4

A classmate who is a good friend of yours depends on you much of the time to help him with his projects in the shop. You like to help him but you also know that if you assist him too much, he will not be learning to use tools properly himself. You also feel that if you refuse to help him any longer, he may be offended and you may lose his friendship. What would you do?

No.	Solution	Frequency
4(a)	Reasoning, counseling (a) Point out that he will be hurt more by being so dependent. (b) Reason with him, point out the error of his way. (c) Tell him in a friendly way;--smile. (d) Tell him that he must try himself.	24
4(b)	Show, but don't do his work (a) Provide confidence by demonstrating how to do it. (b) Show him only, but make him do it himself. (c) Teach him how but don't actually do his work.	23
4(c)	Limit assistance (a) He should basically do his own work. Help him only now and then. (b) Help him for a limited time each day. (c) Limit help to serious problems only. (d) Help him sometimes, refuse other times. (e) Show him once, then ignore him.	22
4(d)	Taper off assistance (a) Help him quite a bit at first and less and less later on. (b) Start him off, then "sneak" back to my own project. (c) Gradually taper off my help.	11

Table 31 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 4

No.	Solution	Frequency
4(e)	Refuse assistance (a) Refuse to help him;--you may be helping him in the long run. (b) Insist that he do it completely himself. (c) Give it to him "straight", and that would be it. (d) Tell him that I can't help him any more.	8
4(f)	Teacher responsibility (a) Tell him to ask the teacher for help. (b) Tell him to ask another student. (c) Ask the teacher to help him. (d) Ask teacher to tell the boy that he must do the work himself.	6
4(g)	Demonstrate on other stock (a) Show him on a scrap piece so that he must do the work on his project himself. (b) Show him on a different project or piece of wood. (c) Show on my project, have him do it on his.	5
4(h)	Tell but not show (a) Tell him, but have him use his own tools. (b) Tell him, but don't show him.	5
4(i)	Claim to be busy (a) Not be "handy" when he needs help. (b) Say "I'm busy." (c) Pretend I'm too busy. (d) Say "I have to get this piece done right away."	5
4(j)	Feign ignorance (a) Play "dumb". (b) Pretend I don't know either. (c) I will ask him the same thing.	4

Table 31 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 4

No.	Solution	Frequency
4(k)	After-hours assistance (a) Work with him after school or at home. Then you could use all of your class time to complete your own projects. (b) Teach him to use the tools some other time.	4
4(l)	Testing - checking up (a) Quiz him on the things you helped him with (next day) (b) Check up on him every ten minutes. (c) Show him and test him.	3
4(m)	Prefer loss of friendship (a) A real friend will realize that you also have a project to complete. (b) I wouldn't care for a friend who would make friendship dependent upon helping him. (c) Lose his friendship because he isn't a real friend anyway.	2
4(n)	Tell him to find out for himself Give him a procedure sheet.	
4(o)	Skill contest Tell him that I would have a contest to see who can make the best project.	
4(p)	Advice Tell to practice at home until he catches on (on his own time).	1
4(q)	Help in the form of problem solving (a) Show him how to do part of the job but leave some parts of it out, so he will have some figuring to do. (b) Have him figure out the "puzzles".	1

Table 31 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 4

No.	Solution	Frequency
4(r)	Find valid reason for not helping Slow up on your own project purposely, but tell him that you would be glad to help him if you weren't so far behind yourself.	1
4(s)	Retaliation Show him how to do it wrong. This will teach him to stop bothering you.	1

Table 32

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 5

After waiting for some time to use a machine in the shop, another boy asks if he can use the machine first because his job will take only a few minutes. After graciously letting him go ahead of you, he finds that the job takes longer than anticipated and he continues to use it for twenty minutes. How would you handle the situation?

No.	Solution	Frequency
5(a)	Demanding, ordering, scolding (a) Tell him to quit, get off machine. (b) Tell him to hurry up. (c) Tell him off,- or else. (d) Tell him to remove himself. (e) Tell him he had better stick to our agreement. (f) Make him go to back of the line. (g) "Go faster or give up machine."	29
5(b)	Asking, reasoning, pleading (a) Ask him to quit (friendly manner) (b) Reason with him, point out the error of his way. (c) Remind him of original agreement. (d) Point out that a good woodworker should know how long it takes.	25

Table 32 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 5

No.	Solution	Frequency
5(c)	Passiveness (a) No problem, just wait and use it when he is through. (b) It's not worth fighting over, let him finish. (c) Be polite and not say anything, but know better next time. (d) You couldn't do anything about it. (e) Ask him why he lied, then excuse him. (f) It's my fault, I let him have it in the first place.	17
5(d)	Plan other activities (a) Start doing a different part of the project. (b) Read a chapter in the book. (c) Do some other job. (d) Help someone else while waiting.	11
5(e)	Belligerence (a) Shove him out of the way. (b) Take the machine away from him. (c) Turn off machine, and put my stock on the machine. (d) Unplug machine, tell him to get lost. (e) Sock him in the mouth.	10
5(f)	Set time limit (a) Set a time limit for him, then tell him to move. (b) Give him five minutes.	6
5(g)	Retaliation (a) Do the same thing with him some time later. (b) Do the same thing later with him and see how he handles it, treat him the same way from then on.	4
5(h)	Teacher responsibility (a) Tell the teacher. (b) Tell the teacher to make him quit. (c) Ask the teacher what to do.	4

Table 32 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 5

No.	Solution	Frequency
5(i)	Prior planning No. 1 Don't allow him to use the machine in the first place.	3
5(j)	Cooperation, No. 1 Ask to take turns with him.	3
5(k)	Threatening (a) Tell him you will do the same with him unless he gives up the machine. (b) Tell him that he will be in trouble unless he gives it to me.	3
5(l)	Cooperation, No. 2 Help him get done so I can get the machine quicker.	2
5(m)	Prior planning, No. 2 (a) Check first how much he has to do. If it is more than what would take a few minutes, don't let him use it. (b) Find out first what he has to do.	2
5(n)	Democratic group agreement If this type of thing persists, the class could set up rules of time limits for using the machines.	1
5(o)	Settle for a later date Tell boy to see to it that he gets a machine for you tomorrow.	1
5(p)	Rejection (a) If he doesn't want to move, cease to be his friend. (b) Don't be nice to him any more.	1

Table 32 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 5

No.	Solution	Frequency
5(q)	Trickery, No. 1 Tell him that he has a mistake to fix, then take the machine when he is back at the bench.	1
5(r)	Trickery, No. 2 Unplug the machine. When he goes to see teacher about what's wrong, claim the machine and keep it.	1
5(s)	Penalty, No. 1 Give him your work to machine when he is done with his.	1
5(t)	Penalty, No. 2 Ask the teacher if a grade penalty can be given for people who do this.	1
5(u)	No response or illegible (Award 129 points).	3

Table 33

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 6

Your job at cleanup time is to sweep the floor. One boy always works for a few minutes after the teacher calls cleanup. As a result he always sweeps the shavings off his bench after you have already swept up. Therefore you must always make a special trip to sweep up his shavings. Repeatedly asking the boy to clean up on time hasn't helped. What would you do?

No.	Solution	Frequency
6(a)	Demand, order, insist (a) Tell him to sweep up the shavings himself. (b) Hand him the broom and make him sweep. (c) Insist that he sweep up his own mess. (d) Use a little force to make him.	33
6(b)	Passiveness (a) Wait for him to finish and then clean up myself. (b) Clean up his shavings for him and he will become disgusted and ashamed. (c) Sweep shavings off from his bench as you go along sweeping the floor.	12

Table 33 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 6

No.	Solution	Frequency
6(c)	Ignore situation (a) Just not clean it up. (b) Leave it;--explain to the teacher if you get blamed. (c) Teacher will notice it, if he continues leaving a mess.	12
6(d)	Leave until last (a) Clean all the rest of the floor first, by that time I will get to that section. (b) Do the other side of the room first.	10
6(e)	Teacher responsibility (a) Tell the teacher. (b) Ask the teacher what to do. (c) Ask the teacher to tell him to clean up.	9
6(f)	Special attention, No. 1 (a) Remind him a few minutes before official clean up time, then he may start earlier. (b) Have him clean up five minutes earlier.	6
6(g)	Asking, reasoning, pleading (a) Ask him to clean up, reason with him. (b) Be polite and talk to him about it. (c) Point out that he may be penalized.	6
6(h)	Retaliation, No. 1 (a) If he is a tool checker (or other job), leave a mess for him. (b) Ask to swap jobs with him, then treat him the same way.	6
6(i)	Threatening (a) Threaten to tell the teacher. (b) Threaten that the teacher will make him a sweeper if he doesn't mend his ways. (c) Threaten to make him sweep the whole floor. (d) Give a fair warning of what will happen to him if he doesn't clean up.	5

Table 33 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY OF OCCURRENCE
PROBLEM NO. 6

No.	Solution	Frequency
6(j)	Special attention, No. 2 (a) Hurry him, stand right there and move him along. (b) Be there when clean up is called, and watch him.	5
6(k)	Retaliation, No. 2 (a) Sweep up other shavings and dump them on top of his work bench. (b) Dump shavings on top of his head. (c) Dump shavings in his locker.	4
6(l)	Early tool pick up (a) Have his tools returned early so that he cannot work after clean up is called. (b) Have tool man pick up his tools before the others.	3
6(m)	Student assistance (a) Have boy next to him watch that he cleans up on time. (b) Have other boy at his bench sweep off the whole bench. (c) Ask other students to keep an eye on him.	2
6(n)	Belligerence (a) Give him a poke in the mouth. (b) Punch him. (c) Hit him if he doesn't respond to telling.	2
6(o)	Cooperation (a) Ask him to help you (both clean up his area). (b) I would sweep off his shavings, he would sweep the floor.	2
6(p)	Retaliation, No. 3 Take my floor broom and push it across his table, sweeping off his shavings, project parts and anything else, then tell him that I will do this every day until he cleans up on time.	2

Table 33 (continued)

BEHAVIORAL UNUSUALNESS, FREQUENCY AND OCCURRENCE
PROBLEM NO. 6

No.	Solution	Frequency
6(q)	Late clean up I would wait until the last minute to clean up.	2
6(r)	Bring attention to student's poor habits Finish job very quickly and hang broom up before he has cleaned up. Then teacher will see what is going on without having to tell on him.	1
6(s)	Retaliation, No. 4 Unscrew his vice for him.	1
6(t)	Penalty Hold his project or tools until he cleans up.	1
6(u)	Taper off help Do it two or three times, then leave it.	1
6(v)	Create a new job Ask teacher to appoint a person to sweep off all benches at clean up time; then responsibility is not yours.	1
6(w)	Ridicule Make a little box and hang it on his bench so he could put scraps in the box.	1
6(x)	No response or illegible (Award 129 points).	1

materially different, and (2) these categories were relatively discreet and of equal importance as problem solutions.

A total unusualness score was computed in somewhat the same manner as was described previously for symbolic and figural unusualness. The frequency of occurrence scores for all six problems were summed for each project. The total scores were then coded, giving scores of one (least unusual) to seven (must unusual), according to a forced, normal distribution. Table 34 summarizes the frequency of occurrence scores, the summed (total) scores and coded scores for subjects R1 through R10. Scores were obtained in the manner shown in Table 34 for all 129 subjects in the total sample.

Table 34

COMPUTATION OF TOTAL BEHAVIORAL UNUSUALNESS SCORES FOR SUBJECTS R1 TO R10

Product No.	Problem Solutions Prob. 1	Prob. 2	Prob. 3	Prob. 4	Prob. 5	Prob. 6	Total	Code
R1	7	11	3	8	1	6	36	7
R2	11	13	13	22	11	33	103	3
R3	3	11	13	23	4	1	55	6
R4	29	11	11	24	3	9	87	4
R5	7	14	25	24	17	33	120	1
R6	2	1	13	23	4	12	55	6
R7	7	11	14	23	29	12	29	3
R8	12	19	8	23	29	6	97	3
R9	5	10	25	1	1	6	48	6
R10	7	2	10	3	3	12	37	7

Evaluation of behavioral usefulness. Behavioral usefulness was defined in terms of the potential success of the solutions offered by the respondent. In other words, to what degree would a solution actually solve the problem at hand? The same two teams who judged symbolic and figural usefulness evaluated all solutions offered by the subjects by assigning the solutions into one of seven categories, from the least to the most useful, according to a forced, normal distribution. In order to make the judging task less complex, the following instructions were given to the rating teams.

> Place the specified number of solutions into each of seven categories in the following manner:
>
> 1. Place the solution(s) which you consider the most useful in category seven.
> 2. Place the solution(s) which you consider the least useful in category one.
> 3. Place the solution(s) which represent average usefulness in category four.
> 4. Place the other solutions in categories from one through seven, depending upon your estimation of the degree of behavioral usefulness involved in the solution.

Instructions were also given to the judges to award a zero to responses which (1) were illegible, or (2) simply referred the problem back to the teacher for solution. At the time of testing, subjects were informed that they should not pass the responsibility for a solution to the teacher. Hence, such responses as "tell the teacher" or "let the teacher decide" were considered irrelevant and therefore unacceptable for the purposes of this study.

An estimate of the inter-rater reliabilities between the behavioral usefulness scores assigned by the two judging teams is revealed by the following reliability coefficients,[93] Problem 1,

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[93] $r = \frac{(\text{MS rows}) - (\text{MS residual})}{\text{MS rows}}$

.82; Problem 2, .87; Problem 3, .89; Problem 4, .77; Problem 5, .88; and Problem 6, .87.

An average of the two team ratings was the final score assigned to each problem solution. Because behavioral creativity scores were derived from six separate problems rather than from one problem, as was the case for symbolic and figural usefulness, it was necessary to compute unusualness and usefulness for each separate problem and then combine these into creativity scores before arriving at a final behavioral score for all six problems. Hence, a total usefulness which evidenced the usefulness of all six problem solutions was not necessary. Table 35 presents the behavioral usefulness team ratings and averaged scores for products R1 to R10.

Combining Unusualness and Usefulness Scores, Approach B

According to Moss' "Theoretical Model", used as basis for this investigation, creativity is the product of unusualness and usefulness (See Appendix B). Moss, in order to determine whether the product or the sum of unusualness and usefulness should be utilized as a predictor of total creativity, correlated both summed and multiplied scores of unusualness and usefulness with post-facto teacher and peer ratings of creativity.[94] He found that the difference in the manner of computing total creativity scores had relatively little influence on the extent of the obtained rank order correlation coefficients. Because of a lack of striking empirical evidence supporting either method, the decision to use the product rather than the sum was made because (a) the range of

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[94] J. Moss, Jr., op. cit., 47.

Table 35

COMPUTATION OF TOTAL BEHAVIORAL USEFULNESS SCORES FOR SUBJECTS R1 TO R10

Subject No.	Problem 1			Problem 2			Problem 3			Problem 4			Problem 5			Problem 6		
	Team 1	Team 2	Avg.	Team 1	Team 2	Avg.	Team 1	Team 2	Avg.	Team 1	Team 2	Avg.	Team 1	Team 2	Avg.	Team 1	Team 2	Avg.
R1	3	1	2.0	3	2	2.5	4	3	3.5	4	2	3.0	2	4	3.0	4	3	3.5
R2	5	5	5.0	6	4	5.0	4	7	5.5	6	5	5.5	6	7	6.5	3	3	3.0
R3	1	1	1.0	2	1	1.5	4	4	4.0	4	5	4.5	5	4	4.5	5	7	6.0
R4	3	4	3.5	2	2	2.0	2	3	2.5	3	3	3.0	4	2	3.0	0	0	0
R5	3	1	2.0	0	0	0	3	3	3.0	4	4	4.0	6	6	6.0	2	2	2.0
R6	2	3	2.5	3	3	3.0	4	6	5.0	4	5	4.5	2	2	2.0	5	5	5.0
R7	2	3	2.5	4	6	5.0	0	0	0	4	5	4.5	4	3	3.5	4	2	3.0
R8	1	5	3.0	3	3	3.0	7	7	7.0	4	5	4.5	3	3	3.0	4	6	5.0
R9	4	6	5.0	6	5	5.5	3	2	2.5	4	6	5.0	2	4	3.0	4	2	3.0
R10	3	2	2.5	7	7	7,0	5	5	5.0	2	3	2.5	5	4	4.5	5	5	5.0

scores could be increased, (b) a zero creativity score would utomatically be assigned to products which were completely useles, i.e., irrelevant to the problem situation.

Scores for symbolic and figural creativity were computedby simply multiplying coded (one through seven) unusualness scors by usefulness scores. Because the measurement of behavioral creativity involved six separate problems, it was necessary t compute the product of unusualness and usefulness for each of the six problems and then compute their arithmetic mean. Comutation used in arriving at a total behavioral creativity score s presented in Table 36 for subjects R1 to R10. Scores for all129 subjects were computed in an identical manner.

A total unusualness score was gained by summing symbolic figural and behavioral unusualness scores. The computation c total creativity was done by summing symbolic, figural and behavioral creativity scores.

Collection of Other Data

This chapter has thus far been concerned completely withthe instrumentation and data collection procedure used for Approah B. The data from Approaches A and C utilized in this study were btained by Moss[95] in connection with a prior investigation, utlizing the same sample. Only a brief description of the data collecion procedure for that investigation is included here. Except fo the teacher ratings of student personality, described later in ths section, all other data were gathered by Moss and his co-workrs

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[95] J. Moss, Jr., op. cit.

Table 36

COMPUTATION OF TOTAL BEHAVIORAL CREATIVITY SCORES FOR SUBJECTS R1 TO R10

Prod. No.		Scores Awarded						Sum of the Products	Sum/6
		Prob. 1	Prob. 2	Prob. 3	Prob. 4	Prob. 5	Prob. 6		
R1	Unus.	6	4	7	5	7	6		
	Usef.	2.0	2.5	3.5	3.0	3.0	3.5		
	Prod.	12.0	10.0	24.5	15.0	21.0	21.0	103.5	17.25
R2	Unus.	5	3	4	1	5	1		
	Usef.	5.0	5.0	5.5	5.5	6.5	3.0		
	Prod.	25.0	15.0	22.0	5.5	32.5	3.0	103	17.17
R3	Unus.	7	4	4	1	7	7		
	Usef.	1.0	1.5	4.0	4.5	4.5	6.0		
	Prod.	7.0	6.0	16.0	4.5	31.5	42.0	107	17.80
R4	Unus.	1	4	4	1	7	6		
	Usef.	3.5	2.0	2.5	3.0	3.0	0		
	Prod.	3.5	8.0	10.0	3.0	21.0	0	45.5	7.58
R5	Unus.	6	3	1	1	4	1		
	Usef.	2.0	0	3.0	4.0	6.0	2.0		
	Prod.	12.0	0	3.0	4.0	24.0	2.0	45.0	7.50
R6	Unus.	7	7	4	1	7	5		
	Usef.	2.5	3.0	5.0	4.5	2.0	5.0		
	Prod.	17.5	21.0	20.0	4.5	14.0	25.0	102	17.00
R7	Unus.	6	4	4	1	1	5		
	Usef.	2.5	5.0	0	4.5	3.5	3.0		
	Prod.	15.0	20.0	0	4.5	3.5	15.0	58	9.67
R8	Unus.	5	1	5	1	1	6		
	Usef.	3.0	3.0	7.0	4.5	3.0	5.0		
	Prod.	15.0	3.0	35.0	4.5	3.0	30.0	90.5	15.08
R9	Unus.	6	4	1	7	7	6		
	Usef.	5.0	5.5	2.5	5.0	4.0	3.0		
	Prod.	30.0	22.0	2.5	35.0	28.0	18.0	135.5	22.58
R10	Unus.	6	7	5	7	7	5		
	Usef.	2.5	7.0	5.0	2.5	4.5	5.0		
	Prod.	15.0	49.0	25.0	17.5	31.5	25.0	163	27.17

in the same semester as the data collected in this investigation, using Test Approach B. The teacher ratings of student personality were gathered by this investigator during the following nine week interval.

Other Measures of Creativity

Test Approach A (teacher ratings of typical performance). The original population of 129 subjects was grouped into three pairs of sections and scheduled so that all students within each pair of sections were taught the same content in the same sequence by the same two teacher-raters over a period of two consecutive nine week quarters. Before the start of the observation period, six teacher-raters completed a seven hour training session concerned with the techniques to be used in the observation and rating of the creative behavior of the sample. The task of each teacher-rater was to observe very closely the behavior of all students in the class to identify unusual behavior as it occurred, then to rate its unusualness and usefulness and classify its content according to the idea inherent in the behavior. The system utilized for rating creative products is outlined in Table 1 of Appendix B. According to this system for identifying and rating creative products, unusualness was based upon the probable frequency of occurrence of an unusual idea, and usefulness was based upon the degree to which the solution satisfied the principal requirements of the problems. A scale of 0-1-2-3 was utilized in order to assess the relative unusualness and usefulness of students' products.

Teachers recorded ratings immediately after observation on a "Pocket Memo" and later in the day transferred such ratings to a permanent "Product Rating" folder which contained a tabulation sheet for each student. In order to establish a basis for estimating the reliability of each teacher's ratings, teacher-raters were instructed to complete an "Anecdotal Record", describing in detail every fifth product rated in each of the symbolic, figural and behavioral content categories. After the close of the total observation period the student products which had been described in the Anecdotal Records were rated by all six teacher-raters on the basis of content classification (symbolic, figural, or behavioral), unusualness and usefulness. An estimate of the inter-rater reliability of these ratings was obtained by comparing each teacher-rater's ratings with the average ratings of the other five teacher-raters on forty products. The coefficients thus obtained averaged .77 for unusualness and .71 for usefulness, and were deemed sufficiently high to warrant their use as criterion measures.

Originally, eight measures were obtained for each subject, corresponding to the same eight individual measures yielded by Approach B. However, because of an insufficient number of ratings of symbolic and behavioral products, subsequent analysis utilized only the criterion measures of figural unusualness, figural creativity, total unusualness and total creativity. The latter two measures included those symbolic and behavioral products which had been observed and rated. Because of an inadequate number of ratings obtained for one of the three pairs of class sections, doubts were raised concerning the reliability of criterion measures for individuals in this group, and it was later dropped from the study.

Since this investigation measured the relative creativity of students in an on-going industrial arts class situation, it was necessary to eliminate from the original population students with exceptional amounts of directly related in-school and out-of-school experiences as well as those with excessive absences. The elimination of one pair of sections from the study, plus reductions carried out for aforementioned reasons, reduced the total sample to 56 subjects, 32 in one group and 24 in the other.

Comparisons made between the resulting data from Approaches A and B were therefore limited to these 32 and 24 students. Frequency of occurrence scores (unusualness) and product ratings (usefulness) for Approach B were recalculated based upon the sample within each group (N = 32 and N = 24) when such data were used for the purpose of comparison with data obtained from Approach A.

Test Approach C. The Minnesota Tests of Creative Thinking represented quite a different approach to the measurement of creative thinking abilities than was evidenced by Approach A. The MTCT consist of several paper and pencil tests, each containing one rather complex task, which can be assembled into various batteries for the purpose of measuring creative abilities.

Form VII of the MTCT consists of four tests, each requiring ten minutes testing time. The tasks selected for this battery were Figure Completion, Circles, Product Improvement and Unusual Uses. Tasks were chosen so as to include both verbal and non-verbal stimuli, requiring verbal and non-verbal responses. Classification of these tasks is given in Table 37.

Table 37

VERBAL, NON-VERBAL CLASSIFICATION OF CREATIVE THINKING TASKS OF THE MINNESOTA TESTS OF CREATIVE THINKING, ABBR. FORM VII

Task	Stimulus	Response
Figure completion	Non-verbal	Non-verbal
Circles	Non-verbal	Non-verbal
Product improvement	Non-verbal	Verbal
Unusual uses	Verbal	Verbal

Following is a description of the four tasks in the MTCT, Abbr. Form VII.

> Figure Completion. Ten incomplete figures were presented. Subjects were to add lines in order to complete an interesting object or picture.
>
> Circles. Subjects were given a sheet of paper on which 36 circles, 1" in diameter, were printed. The task was to think of objects which are made up of circles or have circles in them, and to sketch such modifications on the printed circles.
>
> Product Improvement. A small, stuffed dog was portrayed, Subjects were to suggest as many modifications as they could which would make this toy more fun to play with. Responses were written.
>
> Unusual Uses. The subjects were asked to think of unusual ways in which a tin can might be used. Responses were written.

Scores of fluency, flexibility, originality and elaboration were gained for each subject on the Figure Completion, Circles and Unusual Uses tests. The Product Improvement Test also yielded a separate score for inventivlevel. In addition to total verbal and total non-verbal scores, fluency, flexibility, originality and elaboration were broken down into separate verbal and non-verbal scores.[96]

The fluency score represented the number of relevant, nonredundant responses which a student made.

The flexibility score reflected the ability of the subject to produce a variety of ideas. This score was found by counting the number of categories over which a student's responses were distributed.

The originality score was dependent upon the relative frequency with which such a response had been made by a comparable norm group. A student's score was the sum of weights assigned to his responses.

The elaboration score reflected the ability of a subject to integrate and portray detail. It was scored by awarding points to the number of pertinent ideas which had been added to a primary response.

The inventivlevel score, derived only from the Product Improvement Test, was an attempt to adapt practical criteria for patentable ideas to a particular task, and represented a combination of newness or novelty, usefulness, provocative thought, rarity, originality and the quality of being well thought out.

The MTCT battery was administered to the total sample of 129 subjects approximately half way through the semester data collection period. The battery was given to each class section during a fifty minute class period by the investigator and two assistants who acted as monitors in order to check that students were following directions properly.

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[96] It is often desirable to add standard rather than raw scores in order to give equal weight to all factors. To check this, the fluency, flexibility, originality and elaboration scores of twenty-four students in the study were converted to standard scores, summed and the resultant totals correlated with the sums of the raw scores; a coefficient of .98 was obtained. Since the variances of the four raw score distributions were significantly different (.05), there appeared to be little reason not to use raw score totals throughout the study.

Scoring was done by a qualified assistant who had considerable prior experience in scoring the battery. Scorer reliability was established by having a second qualified assistant rescore, independently, twenty-five tests selected at random from the total group. Inter-scorer reliabilities of from .85 to .96 were reported, indicating a high reliability of scoring procedure.

Post-facto teacher ratings of creativity. Although the inadequacies of post-facto teacher ratings of creativity are well known, the inclusion of such data is justified on the grounds that the scores are helpful as a comparative measure for estimating the construct validity of criterion measures of creativity. At the close of the observation period for each quarter, teachers were asked to name the most creative student, the least creative student, and a student who ranked mid-way between these points, etc., until a total of nine students, representing a continuum from low to high creativity had been identified from the groups which had been observed. Remaining subjects were then identified in a like manner, resulting in scores from one through nine for all subjects within each pair of sections. A final score was gained by averaging the scores of the two teachers who had observed the same two class sections of students. Estimates of reliability for the average post-facto ratings of each pair of teacher raters, although above .70 in the two groups, were found to be no greater than the reliabilities of a single teacher's ratings of student products.

This finding bears out the pessimism with which post-facto teacher ratings of creativity are generally regarded.

Socio-Economic, Aptitude, Achievement and Personality Measures

Socio-economic measures. Data concerning socio-economic status were gathered in order to describe the sample; the relationships between these measures and measures of creative ability were not investigated. The occupational distribution of the samples was obtained from the responses to a "Student Information" form which was distributed to students at the onset of the investigation. A summary of the data obtained in this manner is presented in Table 38. A chi square comparison between the distributions of pairs of the three groups comprising the parents of the original sample indicated significant differences between all pairs of distributions. A significant difference was also found between the occupational distribution of the total sample and distributions of civilian employment in Minnesota and in the United States.

Aptitude measures. Scores of verbal and non-verbal intelligence were available from an administration of the Lorge-Thorndike Intelligence Test, Level 4, Form A during the early part of the seventh grade. These results were available as raw scores on student cumulative record folders, and were converted to I.Q. scores, using student chronological age. The Lorge-Thorndike Intelligence Test, Level 4, Form A seeks to appraise a student's facility for handling concepts and for comprehending the relationships among such concepts.

Table 38

COMPARISON OF PERCENTS OF PARENTAL EMPLOYMENT BETWEEN GROUPS IN THE SAMPLE AND CIVILIAN EMPLOYMENT IN MINNESOTA AND THE UNITED STATES BY MAJOR OCCUPATIONAL CATEGORY

Major Occupational Category	Percent Employment of Parents of Sample[97]				Other Groups	
	Group 1 n=45	Group 2 n=54	Group 3 n=62	Total N=161	Minnesota[98] Civilian Employment	U.S.[99] Civilian Employment
Professional, technical and kindred	33.3	37.0	14.4	29.2	11.5	11.4
Managers, officials and proprietors (ex. farm)	11.1	5.5	3.2	6.2	8.3	8.3
Farmers and farm workers	0.0	0.0	0.0	0.0	10.7	3.9
Clerical and kindred	4.4	5.5	9.7	6.8	14.2	14.9
Sales	15.5	11.1	14.5	13.6	7.5	7.4
Craftsmen, foremen and kindred	24.4	25.9	32.3	28.0	12.9	14.3
Operatives and kindred	2.2	3.7	11.3	6.2	15.3	19.9
Service (inc. private household)	8.9	11.1	8.1	8.7	11.6	11.8
Farm laborers and foremen	0.0	0.0	0.0	0.0	3.4	2.4
Laborers (ex. farm)	0.0	0.0	1.6	.6	4.6	5.5

[97] Ninety-two housewives, one student and four deceased parents have been omitted from this summary.

[98] United States Census of the Population, 1960 - Minnesota, Washington, D.C., U.S. Dept. of Commerce, pp. 25-466-470.

[99] Statistical Abstract of the U.S., 1964, Washington, D.C., U.S. Dept. of Commerce, pp. 229-34.

Achievement measures. Measures of student achievement used in this investigation were of two types. The regular testing program conducted in the schools provided for the administration of five standardized achievement tests which were given about half way through the semester observation period. It was thus possible to gain current raw scores for each of the following tests: (a) Triggs Diagnostic Reading, Form A, Survey Section (total score), (b) STEP Social Studies, Form 3A, (c) STEP writing, Form 3A, (d) Snader General Mathematics, Form AM, and (e) Read General Science, Form AM.

A second measure of student achievement utilized was the average grades received in the seventh grade. These grades, taken from students' cumulative record folders, yielded seven measures of achievement as follows: (a) average seventh grade English (4 quarters), (b) average seventh grade social studies (4 quarters), (c) average seventh grade mathematics (4 quarters), (d) average seventh grade industrial arts (3 quarters), (e) average seventh grade science (2 quarters), (f) average seventh grade art (1 quarter), and (g) overall seventh grade average (equal weight given to each quarterly grade in each subject). To these seven measures was added an eighth, a combined average of seventh and eighth grade industrial arts grades (5 quarters). (The latter measure combined grades from the seventh grade with the two grades earned by students during the observation period of the study.)

Teacher perceptions of student personality. Personality characteristics selected for inclusion in this study were chosen on the basis of their relevance to creative thinking, as expressed in the literature. A graphic personality grading scale was developed by the investigator (See Appendix A), which allowed the teacher-rater to select a rating of one to ten for each subject on each of seven traits of personality. Short descriptive statements of these traits were included on the scale in order to provide the rater with definitions of behavior at various points along the scale. Two personality grading forms were completed for each subject, one by the student's first quarter industrial arts teacher and another by his second quarter industrial arts teacher. The average of these two ratings was the final measure assigned to each subject. Estimates of the inter-rater reliability[100] of ratings assigned by pairs of teachers were as follows: self confidence, .83; temperament, .69; sociability, .68; masculinity, .68; impulsiveness, .77; courtesy, .80; cooperation, .79. These reliability coefficients were deemed sufficiently high to warrant the inclusion of such data in the study.

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[100] $r = \dfrac{\text{MS (rows)} - \text{MS (residual)}}{\text{MS (rows)}}$

CHAPTER IV

FINDINGS: RELATIONSHIPS AMONG MEASURES OF CREATIVITY

A Comparison of Test Approaches

A primary objective of this study was to determine the relationships among measures of creativity as yielded by three instruments representing differing approaches to the evaluation of creative thinking. Approach A utilized teacher ratings of student products as they occurred in typical industrial arts laboratory activities. Specialized performance tests of creativity in industrial arts, developed by this investigator, were utilized in order to gain measures yielded by Approach B. Approach C sought to evaluate creative thinking through measures yielded by the Minnesota Tests of Creative Thinking, Abbr. Form VII, a paper and pencil test developed by E. P. Torrance and his staff.

Approaches B and C. Prior to the numerical analysis of the data yielded by Approaches B and C, it was determined by (1) graphing, or (2) use of Q-sort techniques that all measures might be considered normally distributed in the population.

Means and standard deviations descriptive of the total sample (N = 129) for measures yielded by Approaches B and C are summarized in Table 39. These data will later be compared with similar descriptive data from Groups I and II (Approach A) in order to ascertain the degree to which those two groups were representative of the total sample.

Table 39

MEANS AND STANDARD DEVIATIONS OF SCORES FOR ALL MEASURES OF CREATIVITY FROM APPROACHES B AND C FOR THE TOTAL SAMPLE
N=129

Measure	$\bar{X}$ and s
Specialized Performance Test Measure (Approach B)	
Symbolic unusualness	$\bar{X}$ = 3.97 s = 1.63
Symbolic creativity	$\bar{X}$ = 15.61 s = 8.98
Figural unusualness	$\bar{X}$ = 3.92 s = 1.71
Figural creativity	$\bar{X}$ = 15.71 s = 10.67
Behavioral unusualness	$\bar{X}$ = 3.96 s = 1.59
Behavioral creativity	$\bar{X}$ = 15.61 s = 7.77
Total unusualness	$\bar{X}$ = 11.84 s = 2.90
Total creativity	$\bar{X}$ = 46.37 s = 16.65
MTCT Measures (Approach C)	
Total, non-verbal	$\bar{X}$ = 85.14 s = 27.83
Total, verbal	$\bar{X}$ = 57.98 s = 27.83
Grand total	$\bar{X}$ = 143.29 s = 47.99
Total fluency	$\bar{X}$ = 43.19 s = 16.73
MTCT Measures (Approach C)	
Total flexibility	$\bar{X}$ = 24.81 s = 7.71
Total originality	$\bar{X}$ = 34.92 s = 15.50
Total elaboration	$\bar{X}$ = 40.33 s = 16.62
Total inventivlevel	$\bar{X}$ = 20.64 s = 11.80
Fluency, verbal	$\bar{X}$ = 25.39 s = 13.58
Fluency, non-verbal	$\bar{X}$ = 17.58 s = 5.68
Flexibility, verbal	$\bar{X}$ = 11.09 s = 4.73
Flexibility, non-verbal	$\bar{X}$ = 13.88 s = 4.92
Originality, verbal	$\bar{X}$ = 17.78 s = 11.49
Originality, non-verbal	$\bar{X}$ = 17.14 s = 7.46
Elaboration, verbal	$\bar{X}$ = 3.98 s = 4.22
Elaboration, non-verbal	$\bar{X}$ = 36.27 s = 15.51

Pearson product-moment correlations[101] were developed in order to determine the extent of the relationships among measures yielded by Approaches B and C. Table 40 contains the correlation coefficients between measures yielded by these two approaches for the total sample (N=129). Since only nineteen out of a total of 128 correlations reported are significantly different from zero at the .05 level, the findings suggest that Approaches B and C may not be measuring identical elements of creative thinking.

It is possible that the lack of a high relationship found between Approach B and C measures may be partially explained by the nature of the tasks. The highest correlation coefficients, including seven of the nineteen which are statistically significant, were found between MTCT measures and behavioral creativity (Approach B), possibly reflecting the paper and pencil approach common to both instruments. A paper and pencil response, whether of a verbal or non-verbal nature may require different creative abilities from one which is accomplished through the application of tools and materials to a three-dimensional solution.

A description of Groups I and II. As explained in Chapter III, the criterion measures gathered by Moss, using Test Approach A, were limited to two groups of 32 and 24 students each. Hence comparisons between data from his investigation and the other two test approaches are based upon specially calculated Approach B (specialized performance test) data based upon the same two groups

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[101]

$$r_{xy} = \frac{N \Sigma XY - (\Sigma X)(\Sigma Y)}{\sqrt{[N \Sigma X^2 - (\Sigma X)^2]\ [N \Sigma Y^2 - (\Sigma Y)^2]}}$$

Table 40

CORRELATION COEFFICIENTS† BETWEEN MTCT MEASURES AND SPECIALIZED PERFORMANCE TEST MEASURES OF CREATIVITY FOR THE TOTAL SAMPLE

N=129

	Specialized Performance Test Measures (Approach B)							
MTCT Measures (Approach C)	Symb. Unus.	Symb. Creativity	Fig. Unus.	Fig. Creativity	Behav. Unus.	Behav. Creativity	Total Unus.	Total Creativity
Total non-verbal	.03	-.10	.09	.10	.00	.11	.07	.03
Total verbal	.18*	-.02	.06	.05	-.01	.24*	.13	.03
Grand total	.13	-.07	.09	.09	.00	.21*	.13	.03
Total fluency	.13	-.04	-.01	-.06	-.10	.14	.01	-.09
Total flexibility	.05	-.09	-.01	.05	.00	.11	.05	.01
Total originality	.19*	-.06	.04	.05	.02	.22*	.15	.01
Total elaboration	.03	-.06	.23*	.23*	.06	.19*	.19*	.16
Total inventivlevel	.03	-.09	.05	.05	.01	.10	.06	-.01
Fluency, V	.17*	-.01	.04	-.02	-.09	.19*	.07	-.04
Fluency, NV	.01	-.09	-.12	-.11	-.08	-.01	-.11	-.14
Flexibility, V	.11	-.03	.07	.06	-.02	.10	.10	.03
Flexibility, NV	.01	-.13	-.05	.02	-.02	.04	-.03	-.03
Originality, V	.20*	-.03	.03	.04	-.03	.23	.13	.01
Originality, NV	.10	-.09	.03	.02	.06	.09	.10	.02
Elaboration, V	.02	-.05	.14	.18*	.29*	.23*	.25*	.20*
Elaboration, NV	.04	-.05	.22	.21	-.01	.14	.15	.13

*Significantly different from zero at the .05 level.

†Pearson product-moment correlations.

of subjects. Inasmuch as all creative thinking measures compared with data yielded by Approach A (classroom performance measures) were derived from the two aforementioned groups of subjects, it is desirable to describe those two groups in terms of measures of creativity. The means and standard deviations for all measures of creativity yielded by Approaches A, B, C and post-facto teacher ratings are presented in Table 41. The latter group of measures may be compared with measures of the total sample (N = 129) presented in Table 39, in order to ascertain the degree to which these groups are representative of the total sample. A comparison of the data revealed that means for the total sample were not significantly different from either of the two group means. In all cases the means of Approach C measures of the total sample fell between those of Group I and Group II. Means of Approach B measures for the total sample fell between those of Group I and Group II in four cases, and were slightly higher or lower than either group mean in the other four cases. It may be concluded that Groups I and II were fairly representative of the total sample.

Approaches A and B. Table 42 presents the Pearson product-moment correlation coefficients between measures yielded by Approaches A and B for Groups I and II. Correlation coefficients between measures yielded by these instruments ranged from -.22 to .36. The highest correlation coefficients were found between figural measures. It is understandable that the relationships between the aforementioned measures should exceed relationships between Approach A measures and Approach B symbolic and behavioral

Table 41

MEANS AND STANDARD DEVIATIONS OF SCORES FOR ALL MEASURES OF CREATIVITY FROM APPROACHES A, B, C AND POST-FACTO TEACHER RATINGS FOR GROUPS I AND II

Measure	Group I (N=32)	Group II (N=24)
Classroom Performance Measures of Creativity (Approach A)		
Figural unusualness	$\bar{X}$ = 50.09* s = 9.67	50.13 9.37
Total unusualness	$\bar{X}$ = 50.13* s = 9.64	50.25 9.56
Figural creativity	$\bar{X}$ = 50.03* s = 9.71	50.25 9.65
Total creativity	$\bar{X}$ = 49.78* s = 9.71	50.17 9.62

* T scores ($\bar{X}$ = 50, s = 10)

Specialized Performance Tests of Creativity (Approach B)		
Symbolic unusualness	$\bar{X}$ = 4.03** s = 1.62	3.88 1.83
Symbolic creativity	$\bar{X}$ - 15.84 s = 7.84	15.79 10.60
Figural unusualness	$\bar{X}$ = 3.88** s = 1.79	3.85 1.71
Figural creativity	$\bar{X}$ = 16.25 s = 10.74	16.13 9.78
Behavioral unusualness	$\bar{X}$ = 3.94** s = 1.64	3.92 1.61
Behavioral creativity	$\bar{X}$ = 16.11 s = 6.49	14.06 4.56
Total unusualness	$\bar{X}$ = 11.84 s = 2.85	11.58 2.32
Total creativity	$\bar{X}$ = 47.93 s = 17.56	45.98 13.34

** Forced normal distribution (1 to 7 scale)

Table 41 (continued)

Measure	Group I	Group II
Teacher Rating		
Post-facto teacher rating of creativity	$\bar{X}$ = 4.67	4.65
	s = 1.75	1.59
MTCT Measures (Approach C		
Total, non-verbal	$\bar{X}$ = 88.50	78.25
	s = 28.23	28.28
Total, verbal	$\bar{X}$ = 63.25	45.17*
	s = 25.73	24.81
Grand total	$\bar{X}$ =151.94	123.42*
	s = 46.89	45.24
Total fluency	$\bar{X}$ = 44.66	35.79*
	s = 16.64	14.86
Total flexibility	$\bar{X}$ = 25.31	22.88
	s = 6.77	8.40
Total originality	$\bar{X}$ = 38.13	29.54*
	s = 14.51	12.41
Total elaboration	$\bar{X}$ = 43.66	35.21
	s = 18.76	17.46
Total inventivlevel	$\bar{X}$ = 22.25	15.00*
	s = 7.97	10.56
Fluency, verbal	$\bar{X}$ = 27.00	18.38*
	s = 13.62	11.22
Fluency, non-verbal	$\bar{X}$ = 17.66	17.38
	s = 5.86	5.80
Flexibility, verbal	$\bar{X}$ = 13.22	9.71
	s = 9.57	5.09
Flexibility, non-verbal	$\bar{X}$ = 14.41	13.21
	s = 5.19	5.14
Originality, verbal	$\bar{X}$ = 20.03	13.25*
	s = 10.65	9.67
Originality, non-verbal	$\bar{X}$ = 20.06	15.88*
	s = 14.87	6.28
Elaboration, verbal	$\bar{X}$ = 5.22	3.88
	s = 5.08	5.24
Elaboration, non-verbal	$\bar{X}$ = 37.09	30.96
	s = 19.12	15.51

* Difference between means statistically significant at the .05 level.

Table 42

CORRELATION COEFFICIENTS† BETWEEN CLASSROOM PERFORMANCE MEASURES AND SPECIALIZED PERFORMANCE TEST MEASURES OF CREATIVITY FOR GROUPS I AND II

Group I (N=32), Group II (N=24)

		Classroom Performance Measures (Approach A)			
Specialized Performance Test Measures (Approach B)	Group	Fig. Unus.	Total Unus.	Fig. Creativity	Total Creativity
Symbolic unusualness	I	.07	.07	-.02	.00
	II	-.17	-.20	-.10	-.12
Symbolic creativity	I	-.04	.00	.00	.03
	II	-.13	-.15	-.08	-.10
Figural unusualness	I	.25	.26	.25	.25
	II	.17	.20	.04	.09
Figural creativity	I	.32	.36*	.29	.33
	II	.10	.13	-.04	.02
Behavioral unusualness	I	-.21	-.17	-.22	-.19
	II	-.02	.03	.00	.04
Behavioral creativity	I	-.14	-.08	-.21	-.17
	II	.10	.09	.10	.10
Total unusualness	I	.08	.10	.02	.04
	II	-.03	.00	-.07	-.02
Total creativity	I	.13	.19	.12	.17
	II	.00	.00	-.05	-.04

* Statistically different from zero at the .05 level.

† Pearson product-moment correlations.

measures because "total unusualness", Approach A, represented 91 percent figural creativity, 6 percent symbolic creativity, and 3 percent behavioral creativity.[102] This finding is also understandable because Moss reports an almost complete interdependence among his four criterion measures, with correlations ranging from .93 to 1.00.[103] However, the lack of high relationships between figural measures indicates that the two approaches are probably not measuring the same characteristic.

The lack of consistently high correlation coefficients between the two groups on figural measures might be accounted for, in part, by motivational factors. Specialized performance tests used in Approach B were of a fifty minute duration, and students were highly motivated to achieve at a peak level of performance for that short period of time. On the other hand, the typical classroom performance measures yielded by Approach A were gathered throughout an eighteen week time interval, without similar motivational influences. The typical classroom performance measures may be indicative of what a student usually does, while the specialized performance test measures may be suggestive of that he is capable of doing.

Another possible explanation for the lack of strong relationships among the aforementioned measures may lie in the dissimilarity of the nature of the tasks upon which evaluation was based. The planning and construction of a specified object, in a specified amount of time, using specified tools and materials, represents a more restrictive task, and possibly calls for a somewhat different combination of creative abilities than might be evidenced through a wide variety of tasks dependent upon self-initiated behavior as well as teacher-initiated behavior.

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[102] J. Moss, Jr., _op_. _cit_., 45.

[103] _Ibid_., 48-49.

A difference in the substantive requirements of Approaches A and B may also be an influential factor in accounting for the apparent lack of relationships. Approach A measures, being dependent upon typical student performance, required students to use actual substantive industrial arts content. Approach B measures, on the other hand, dealt with limited and simulated industrial arts content.

Approaches A and C. Although this investigation was primarily concerned with the relationships of criterion measures yielded by Approach B, the relationships between MTCT measures (Approach C) and typical performance measures (Approach A) of creativity are also of interest and are reported here in order to complete the total picture. Table 43 summarizes Pearson product-moment correlation coefficients found between Approach A and Approach C measures for Groups I and II, as reported by Moss.[104] The principal findings were summarized by him as follows:

> (a) The coefficients between MTCT and criterion measures for Group I were almost all insignificant, but for Group II, verbal, grand total, originality, elaboration and inventivlevel coefficients were significant; only verbal and inventivlevel coefficients in Group II, however, even approached a magnitude that indicated a practically useful degree of concurrent validity; (b) with few exceptions Group II coefficients were higher than those in Group I; the verbal and inventivlevel coefficients in Group II were significantly greater than Group I coefficients at the

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[104] Ibid., 52-53.

Table 43

CORRELATION COEFFICIENTS† BETWEEN *MTCT, ABBR. FORM VII* MEASURES AND CLASSROOM PERFORMANCE MEASURES OF CREATIVITY FOR GROUPS I AND II[105]

Group I (N=32), Group II (N=24)

MTCT Measures (Approach C)	Group	Classroom Performance Measures of Creativity (Approach A)			
		Figural Unusualness	Total Unusualness	Figural Creativity	Total Creativity
Non-verbal	I	.42*	.39*	.29	.26
	II	.22	.23	.23	.27
Verbal	I	.11	.10	-.12	-.10
	II	.58*	.60*	.60*	.63*
Grand total	I	.31	.29	.11	.10
	II	.46*	.47*	.47*	.51*
Fluency	I	.14	.12	-.08	-.07
	II	.32	.33	.36	.39
Flexibility	I	.13	.11	-.03	-.05
	II	.35	.40	.38	.43*
Originality	I	.21	.18	.04	.02
	II	.40	.44*	.43*	.48*
Elaboration	I	.45*	.44*	.33	.31
	II	.47*	.43*	.43*	.45*
Inventivlevel	I	.14	.14	.01	.04
	II	.64*	.64*	.64*	.68*

* Significantly different from zero at the .05 level.

† Pearson product-moment correlations.

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[105] *Ibid.*, 52.

.05 level; (c) the coefficients for both groups show that the criterion measures of figural unusualness and total unusualness were almost identical, and that figural creativity and total creativity were almost identical; in Group II, all four measures were almost identical, but in Group I the unusualness and creativity measures yielded somewhat different coefficients.

Post-facto teacher ratings of creativity. As was indicated previously, post-facto teacher ratings of creativity were originally obtained in order to estimate the construct validity of Approach A measures. The correlation coefficients among post-facto teacher ratings and measures yielded by Approaches A, B and C for Groups I and II are presented in Table 44. The findings may be summarized as follows: (a) All correlation coefficients between Approach A measures and post-facto teacher ratings were significant at the .05 level for both groups. (b) For Approach B, only the three measures of figural unusualness, figural creativity, and total creativity for Group I produced statistically significant correlations with post-facto teacher ratings. For Group II, only Approach C elaboration (verbal) showed a statistically significant correlation.

Certain hypotheses may be formulated: (a) It would appear from the foregoing that post-facto teacher ratings of creativity may heavily reflect figural creativity due to the nature of the opportunities provided in an industrial arts environment. (b) Total elaboration may be the best, most consistent MTCT measure of the creative attributes which may be of a figural nature. The data in Tables 40 and 43 seem to support this hypothesis. (c) The finding that measures yielded by Approach A were more highly correlated with post-facto teacher ratings than were measures from Approaches B and C is partially understandable, inasmuch as

Table 44

CORRELATION COEFFICIENTS† BETWEEN MEASURES YIELDED BY APPROACHES A, B, AND C AND POST-FACTO TEACHER RATINGS OF CREATIVITY FOR GROUPS I AND II
Group I (N=32), Group II (N=24)

Classroom Performance Measures	Group	Post-facto Teacher Rating
Figural unusualness	I	.54*
	II	.83*
Total unusualness	I	.57*
	II	.83*
Figural creativity	I	.53*
	II	.78*
Total creativity	I	.55*
	II	.80*
Specialized Performance Test Measures		
Symbolic unusualness	I	-.17
	II	-.05
Symbolic creativity	I	.04
	II	-.16
Figural unusualness	I	.50*
	II	.24
Figural creativity	I	.55*
	II	.21
Behavioral unusualness	I	-.19
	II	.15
Behavioral creativity	I	.04
	II	.09
Total unusualness	I	.11
	II	.24
Total creativity	I	.41
	II	.06

MTCT Measures	Group	Post-facto Teacher Rating
Total NV	I	.37*
	II	.11
Total V	I	.14
	II	.39
Grand total	I	.30
	II	.29
Total fluency	I	.12
	II	.11
Total flexibility	I	.09
	II	.24
Total originality	I	.08
	II	.28
Total elaboration	I	.55*
	II	.33
Total inventivlevel	I	.28
	II	.39
Fluency, V	I	.13
	II	.14
Fluency, NV	I	.04
	II	.01
Flexibility, V	I	.45*
	II	.34
Flexibility, NV	I	.14
	II	.05
Originality, V	I	.03
	II	.38
Originality, NV	I	.27
	II	-.02
Elaboration, V	I	.30
	II	.53*
Elaboration, NV	I	.30
	II	.24

* Statistically significant from zero at the .05 level.

† Pearson product-moment correlations.

post-facto ratings were assigned by the same teacher-raters who assigned Approach A product ratings. On the other hand, Moss also obtained peer ratings of creativity which correlated significantly with Approach A and post-facto teacher ratings.

Relationships Among Measures Within Approaches

Intercorrelations. The intercorrelations among measures yielded by Approaches B and C for the total sample of 129 are presented in Tables 45 and 46.

Table 45

INTERCORRELATIONS† BETWEEN SPECIALIZED PERFORMANCE TEST MEASURES OF CREATIVITY
(N=129)

Approach B Variable	1	2	3	4	5	6	7	8
1. Symbolic unusualness								
2. Symbolic creativity	.70*							
3. Figural unusualness	.15	.20*						
4. Figural creativity	.13	.20*	.76*					
5. Behavioral unusualness	-.09	-.01	.01	.04				
6. Behavioral creativity	.01	.00	.06	.01	.38*			
7. Total unusualness	.60*	.50*	.67*	.54*	.50*	.25*		
8. Total creativity	.46*	.66*	.60*	.78*	.26*	.23*	.75*	

* Statistically significant from zero at the .05 level.
† Pearson product-moment correlations.

Table 46

INTERCORRELATIONS† BETWEEN MTCT, ABBR. FORM VII MEASURES OF CREATIVITY (N=129)

Approach C Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1. Total non-verbal																
2. Total verbal	.49															
3. Grand total	.86	.86														
4. Total fluency	.64	.89	.89													
5. Total flexibility	.73	.73	.85	.76												
6. Total originality	.71	.84	.90	.78	.76											
7. Total elaboration	.85	.48	.76	.47	.51	.53										
8. Total inventivlevel	.46	.71	.67	.63	.52	.61	.49									
9. Fluency, V	.45	.93	.80	.94	.65	.74	.37	.62								
10. Fluency, NV	.76	.38	.66	.66	.67	.53	.44	.32	.39							
11. Flexibility, V	.31	.76	.62	.64	.75	.56	.28	.46	.68	.29						
12. Flexibility, NV	.79	.42	.70	.57	.82	.65	.48	.36	.38	.76	.29					
13. Originality, V	.48	.95	.83	.82	.67	.90	.42	.66	.85	.37	.64	.44				
14. Originality, NV	.74	.30	.61	.38	.55	.71	.45	.26	.25	.54	.19	.67	.33			
15. Elaboration, V	.13	.17	.17	-.07	.09	.13	.40	.25	-.08	-.04	.04	.07	.11	.09		
16. Elaboration, NV	.87	.46	.77	.52	.51	.54	.96	.45	.43	.49	.29	.49	.43	.47	.15	

* Correlation coefficients of .17 and above are significant at the .05 level.

† Pearson product-moment correlations.

Reported intercorrelations among Approach B measures support the supposition that the three content categories of creative abilities are not highly related. On the other hand, the relatively high correlation between symbolic unusualness and symbolic creativity, and between figural unusualness and figural creativity may suggest that the ability to produce unusual products may be closely related to the ability to produce useful products within a given content category. As was pointed out in a previous chapter, the systems for scoring unusualness and usefulness were in no way related.

Only 12 of 120 intercorrelations among Approach C measures were statistically insignificant. It is notable that eleven of these correlation coefficients were between elaboration (verbal) and other MTCT measures. Elaboration (verbal) appeared to represent a quite different ability than all other measures in the battery. Although separate verbal and non-verbal scores were not available for comparisons between Approaches A and C, statistically significant correlations between MTCT elaboration and all Approach A measures reported in Table 43 support the supposition that elaboration may be the one MTCT measure which comes closest to predicting measures of figural creativity.

In Table 47 are presented the intercorrelations among measures yielded by Approach A. An almost complete interdependence is observed among the four measures. Because only a small percentage of symbolic and behavioral ratings were incorporated in the total measures this lack of discrimination among measures is expected. Moss reports, ". . . the investigator hypothesized that

Table 47

INTERCORRELATIONS† BETWEEN CLASSROOM PERFORMANCE MEASURES OF CREATIVITY FOR GROUPS I AND II

Group I (N=32)

Approach A Variable	1	2	3	4
1. Figural unusualness				
2. Total unusualness	.98*			
3. Figural creativity	.94*	.93*		
4. Total creativity	.93*	.95*	.98*	

Group II (N=24)

Approach A Variable	1	2	3	4
1. Figural unusualness				
2. Total unusualness	.98*			
3. Figural creativity	.95*	.93*		
4. Total creativity	.96*	.97*	.98*	

* Statistically significant from zero at the .05 level.

† Pearson product-moment correlations.

the single ability or group of abilities measured by the product rating procedure was figural creativity in industrial arts."[106]

Prediction of specialized performance test measures. In order to determine the extent of the relationships between the best combination of MTCT, Abbr. Form VII measures and each Approach B measure, multiple linear regression equations were developed for the total sample (N = 129) and also for Groups

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[106] Ibid., 49.

I (N = 32) and II (N = 24). Two sets of equations were developed; in order to decrease the extent of interdependence among measures, MTCT fluency, flexibility, originality, elaboration and inventivlevel were employed as independent variables for one set of equations, while MTCT non-verbal and verbal measures comprised the second set of equations. Tables 48 and 49 present the resultant multiple linear regression coefficients and ordinary and normal partial regression coefficients between the measures yielded by Approaches B and C.

The findings summarized in these tables indicate that, as expected, a combination of Approach C measures yielded a more efficient prediction of the Approach B criterion measures than any single MTCT measure, but that no combination resulted in a sufficiently high enough coefficient to be of practical use. The following observations are made concerning the relative contributions to the nine variable equations in Table 48.

(a) Originality (non-verbal) contributed the most to symbolic unusualness.
(b) Originality (verbal) contributed the most to symbolic creativity.
(c) Inventivlevel contributed the most to figural unusualness.
(d) Inventivlevel and flexibility (verbal) contributed the most to figural creativity.
(e) Elaboration (non-verbal) contributed the most to behavioral unusualness.
(f) Fluency (non-verbal) contributed the most to behavioral creativity.
(g) Elaboration (non-verbal) contributed the most to total unusualness.
(h) Flexibility (verbal) contributed the most to total creativity.

It is noted that the partial regression coefficients of MTCT variables which contribute the most to the Approach B independent variables (See Table 48) do not necessarily contribute the highest

Table 48

MULTIPLE CORRELATION COEFFICIENTS AND ORDINARY AND NORMAL PARTIAL REGRESSION COEFFICIENTS OF MTCT, ABBR. FORM VII SCORES PREDICTING SPECIALIZED PERFORMANCE TEST MEASURES OF CREATIVITY

(N=129)

Dependent Variable	R	Equation	Constant	MTCT Variables								
				Fluency V	Fluency NV	Flexibility V	Flexibility NV	Originality V	Originality NV	Elaboration V	Elaboration NV	Inventiv-level
Symbolic unusualness	.28	Ordinary	3.89	-.03	.01	-.00	-.01	-.05	.05	.03	.01	-.00
		Normal		-.19	.08	-.01	-.04	-.16	.32	.15	.04	-.03
Symbolic creativity	.17	Ordinary	19.25	-.09	.07	-.01	-.07	-.25	.03	-.01	-.03	.02
		Normal		-.13	.10	-.01	-.04	-.14	.04	-.01	-.01	.04
Figural unusuality	.36*	Ordinary	3.66	-.01	.01	-.09	.03	.00	-.02	.01	.04	.04
		Normal		-.05	.09	-.31	.09	-.01	-.14	.05	.10	.35
Figural creativity	.38*	Ordinary	14.25	-.05	-.11	-.65	.27	.35	.03	-.08	.26	.24
		Normal		-.06	-.15	-.35	.12	.16	.04	-.06	.10	.35
Behavioral unusualness	.32	Ordinary	3.81	.00	-.01	-.02	.01	-.01	.00	.03	.11	.00
		Normal		-.01	-.06	-.08	.04	-.03	-.01	.13	.28	-.03
Behavioral creativity	.37*	Ordinary	13.33	-.13	.14	-.14	-.15	-.09	.13	.07	.49	.04
		Normal		-.20	.25	-.10	-.09	-.06	.02	.07	.03	.08
Total unusualness	.38*	Ordinary	11.31	-.03	.02	-.12	.04	-.06	.02	.07	.16	.03
		Normal		-.14	.07	-.23	.06	-.11	.09	.18	.24	.17
Total creativity	.33	Ordinary	46.90	-.18	-.09	-.81	.27	.35	.08	-.12	-.64	.28
		Normal		-.13	-.07	-.28	.08	.10	.06	-.06	.16	.26

* R^2 significantly different from zero at the .05 level.

Table 49

MULTIPLE CORRELATION COEFFICIENTS AND ORDINARY AND NORMAL PARTIAL REGRESSION COEFFICIENTS OF VERBAL AND NON-VERBAL *MTCT, ABBR. FORM VII* SCORES PREDICTING SPECIALIZED PERFORMANCE TEST MEASURES OF CREATIVITY (N=129)

Dependent Variable	R	Equation	Constant	MTCT Variables Total NV	 Total V
Symbolic unusualness	.19	Ordinary	3.60	.00	.01
		Normal		-.07	.22
Symbolic creativity	.11	Ordinary	18.24	-.04	.01
		Normal		-.12	.03
Figural unusualness	.10	Ordinary	3.41	.00	.00
		Normal		.08	.03
Figural creativity	.10	Ordinary	12.39	.04	.00
		Normal		.10	.00
Behavioral unusualness	.02	Ordinary	3.99	.00	.00
		Normal		.01	-.03
Behavioral creativity	.24*	Ordinary	11.88	.00	.07
		Normal		-.01	.25
Total unusualness	.14	Ordinary	10.97	.00	.01
		Normal		.00	.14
Total creativity	.03	Ordinary	44.85	.01	.01
		Normal		.02	.02

* R^2 significantly different from zero at the .05 level.

zero order correlation coefficients between the same variables (See Table 40). This is explained by the relatively high intercorrelation reported among Approach C variables (See Table 46).

In Table 49 the correlation coefficients are considerably lower than those reported in Table 48 between the nine variable equations and criterion measures. It is worthy of mention that neither total verbal or total non-verbal measures made a consistently high contribution to the Approach B measures.

In Tables 50 and 51 are reported multiple linear regression correlations and ordinary and normal partial regression coefficients of MTCT scores predicting classroom performance measures of creativity (Approach A) for Groups I and II respectively. MTCT measures of fluency, flexibility, originality, elaboration and inventivlevel are reported as the independent variable for one set of equations, as reported in Table 50, and MTCT measures of total non-verbal and total verbal are reported as the independent variable for a second set of equations, as reported in Table 51.

For comparative purposes, similar multiple linear regression equations were developed for Approach B measures, basing the data on measures yielded from the same two groups as were used to gather data for Approach A. The resultant correlation coefficients are reported in Tables 52 and 53.

It was evident that the coefficients were generally higher between MTCT measures and Approach A measures than they were when Approach B measures were used as the criteria. Once again it was observed that a combination of MTCT scores was a better predictor of individual measures yielded by Approaches A and B than any single MTCT measure. It is necessary to point out, however, that a reduction of .03 to .22 (with the largest reduction in the smallest coefficients, using the five independent variables) may be anticipated when estimating the probable multiple coefficients for the hypothetical universe from which the sample was drawn.[108]

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[108] $cR^2 = 1 - (1 - R^2)\frac{(N - 1)}{(N - M)}$ in Guilford, J. P. Fundamentals of Statistics in Psychology and Education, 2nd ed., (New York, N. Y.: McGraw-Hill and Co., 1950.

Table 50

MULTIPLE CORRELATION COEFFICIENTS[107] AND ORDINARY AND NORMAL PARTIAL REGRESSION COEFFICIENTS OF *MTCT, ABBR. FORM VII* SCORES PREDICTING CLASSROOM PERFORMANCE MEASURES OF CREATIVITY

Group I, N=32

Dependent Variable	R	Equation	Constant	Total Fluency	Total Flexibility	Total Originality	Total Elaboration	Total Inventivlevel
Figural unusualness	.48	Ordinary	44.26	.02	-.32	.10	.27	-.11
		Normal		.03	-.23	.15	.52	-.09
Total unusualness	.47	Ordinary	44.67	.04	-.33	.05	.26	-.05
		Normal		.06	-.23	.07	.52	-.04
Figural creativity	.42	Ordinary	49.42	-.12	-.23	.10	.24	-.09
		Normal		-.21	-.16	.15	.46	-.07
Total creativity	.40	Ordinary	49.25	-.07	-.29	.02	.23	.00
		Normal		-.13	-.20	.03	.45	.00

Group II, N=24

Dependent Variable	R	Equation	Constant	Total Fluency	Total Flexibility	Total Originality	Total Elaboration	Total Inventivlevel
Figural unusualness	.75*	Ordinary	42.88	-.45	.37	.03	.05	.85
		Normal		-.72	.33	.03	.09	.97
Total unusualness	.75*	Ordinary	42.33	-.50	.47	.06	.00	.88
		Normal		-.78	.42	.07	.01	.97
Figural creativity	.72*	Ordinary	42.03	-.40	.37	.04	.02	.83
		Normal		-.62	.33	.05	.03	.91
Total creativity	.77*	Ordinary	41.09	-.45	.42	.09	.00	.87
		Normal		-.70	.37	.11	.00	.95

*R^2 significantly different from zero at the .05 level.

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[107] Reported by J. Moss, *op. cit.*, 53.

Table 51

MULTIPLE CORRELATION COEFFICIENTS AND ORDINARY AND NORMAL PARTIAL REGRESSION COEFFICIENTS OF VERBAL AND NON-VERBAL MTCT, ABBR. FORM VII SCORES PREDICTING CLASSROOM PERFORMANCE MEASURES (APPROACH A) OF CREATIVITY

Group I (N=32)

Dependent Variable	R	Equation	Constant	Total NV	Total V
Figural unusualness	.44*	Ordinary	38.49	.17	-.06
		Normal		.49	-.15
Total unusualness	.41	Ordinary	39.36	.16	-.05
		Normal		.47	-.14
Figural creativity	.42	Ordinary	44.23	.16	-.14
		Normal		.47	-.36
Total creativity	.37	Ordinary	44.55	.14	-.12
		Normal		.42	-.31

Group II (N=24)

Dependent Variable	R	Equation	Constant	Total NV	Total V
Figural unusualness	.58*	Ordinary	41.07	-.02	.23
		Normal		-.05	.60
Total unusualness	.60*	Ordinary	40.87	-.02	.24
		Normal		-.06	.63
Figural creativity	.60*	Ordinary	40.61	-.02	.24
		Normal		-.05	.62
Total creativity	.63*	Ordinary	39.52	-.01	.25
		Normal		-.02	.64

* R^2 significantly different from zero at the .05 level.

Table 52

MULTIPLE CORRELATION COEFFICIENTS AND ORDINARY AND NORMAL PARTIAL REGRESSION COEFFICIENTS OF MTCT, ABBR. FORM VII SCORES PREDICTING SPECIALIZED PERFORMANCE TEST MEASURES OF CREATIVITY

Group I, N=32

Dependent Variable	R	Equation	Constant	MTCT Measures: Total Fluency	Total Flexibility	Total Originality	Total Elaboration	Total Inventiv-level
Symbolic unusualness	.41	Ordinary	4.39	-.01	-.01	.05	-.04	.00
		Normal		-.09	-.02	.41	-.42	.00
Symbolic creativity	.33	Ordinary	21.22	-.03	.09	.02	-.15	-.02
		Normal		-.07	.08	.03	-.35	-.02
Figural unusualness	.36	Ordinary	3.14	.03	-.03	-.03	.04	-.01
		Normal		.30	-.13	-.27	.38	-.04
Figural creativity	.48	Ordinary	18.21	-.08	-.23	-.13	.31	-.05
		Normal		-.12	-.14	-.18	.53	-.03
Behavioral unusualness	.38	Ordinary	5.32	-.03	-.06	.02	.01	.02
		Normal		-.34	-.23	.18	.08	.10
Behavioral creativity	.35	Ordinary	16.85	-.18	-.18	-.11	.10	.19
		Normal		-.05	-.18	-.24	.30	.23
Total unusualness	.19	Ordinary	12.85	-.01	-.10	.03	.01	.01
		Normal		.06	-.23	.17	.05	.03
Total creativity	.34	Ordinary	57.36	-.15	-.39	-.18	.28	.07
		Normal		-.14	-.15	-.15	.30	.03

Table 52 (continued)

Group II, N=24

				MTCT Measures				
Dependent Variable	R	Equation	Con-stant	Total Fluency	Total Flexi-bility	Total Origi-nality	Total Elabo-ration	Total Inventiv-level
Symbolic unusualness	.47	Ordinary	3.00	.03	-.14	.12	.03	-.11
		Normal		.25	-.66	.81	.31	-.62
Symbolic creativity	.43	Ordinary	9.33	.30	-.31	.27	.17	-.72
		Normal		.41	-.25	.31	.28	-.72
Figural unusualness	.32	Ordinary	3.36	.04	.10	-.10	-.01	.01
		Normal		.33	.52	-.76	-.07	.04
Figural creativity	.46	Ordinary	17.43	.13	.84	-.89	-.06	.25
		Normal		.19	.72	-1.14	-.11	.27
Behavioral unusualness	.54	Ordinary	6.11	-.10	-.02	.05	-.02	.07
		Normal		-.89	-.13	.37	.22	.49
Behavioral creativity	.49	Ordinary	15.34	-.12	.40	-.20	-.12	.27
		Normal		-.39	.75	-.55	-.48	.63
Total unusualness	.28	Ordinary	12.69	-.05	-.05	.07	.01	-.03
		Normal		-.35	-.17	.38	.05	-.12
Total creativity	.37	Ordinary	42.09	.30	.93	.83	-.02	-.20
		Normal		.34	.59	-.77	-.02	-.16

Table 53

MULTIPLE CORRELATION COEFFICIENTS AND ORDINARY AND NORMAL PARTIAL REGRESSION COEFFICIENTS OF VERBAL AND NON-VERBAL *MTCT, ABBR. FORM VII* SCORES PREDICTING SPECIALIZED PERFORMANCE TEST MEASURES OF CREATIVITY

Group I (N=32)

Dependent Variable	R	Equation	Constant	MTCT Non-verbal	MTCT Verbal
Symbolic unusualness	.23	Ordinary	4.58	-.01	.01
		Normal		-.25	.19
Symbolic creativity	.37	Ordinary	23.46	-.12	.04
		Normal		-.42	.14
Figural unusualness	.20	Ordinary	2.71	.01	.01
		Normal		.14	.08
Figural creativity	.08	Ordinary	15.38	.03	-.03
		Normal		.08	-.08
Behavioral unusualness	.21	Ordinary	5.06	-.01	-.01
		Normal		-.14	-.10
Behavioral creativity	.07	Ordinary	16.92	-.02	.01
		Normal		-.08	.05
Total unusualness	.12	Ordinary	12.35	-.01	.01
		Normal		-.13	.10
Total creativity	.15	Ordinary	55.85	-.10	.02
		Normal		-.16	.02

Group II (N=24)

Dependent Variable	R	Equation	Constant	MTCT Non-verbal	MTCT Verbal
Symbolic unusualness	.31	Ordinary	2.64	.02	-.01
		Normal		.34	-.15
Symbolic creativity	.27	Ordinary	10.24	.11	-.07
		Normal		.30	-.17
Figural unusualness	.07	Ordinary	3.90	.00	.01
		Normal		-.05	.07
Figural creativity	.18	Ordinary	20.76	-.07	.02
		Normal		.20	.04
Behavioral unusualness	.36	Ordinary	5.48	-.01	-.01
		Normal		-.21	-.22
Behavioral creativity	.28	Ordinary	16.34	-.05	.04
		Normal		-.31	.20
Total unusualness	.26	Ordinary	12.19	.01	-.03
		Normal		.10	-.29
Total creativity	.04	Ordinary	47.34	-.01	-.02
		Normal		-.01	-.04

Using the same independent variables as were described in connection with the multiple linear regression equations, an approximate test of standard partial regression coefficients[109] was carried out in order to discover and describe the relationships of the sixteen equations (using eight dependent variables) for each group of subjects. It was found that the following equations were significantly different (.05 level) from each other:

Group 1

a) Symbolic unusualness and figural creativity.

Group 2

a) Symbolic unusualness and behavioral unusualness.
b) Symbolic unusualness and figural creativity.
c) Symbolic unusualness and behavioral creativity.
d) Symbolic creativity and behavioral creativity.

The equations for Group I were significantly different at the .05 level from those developed for Group II in only three cases. We thus have evidence of a moderate dissimilarity among equations developed for criterion measures.

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[109] The approximation $Z = \frac{B_1 - B_2}{\sqrt{S_1^2 + S_2^2}}$ was used.

CHAPTER V

FINDINGS: RELATIONSHIPS AMONG CREATIVITY, INTELLIGENCE, ACHIEVEMENT AND PERSONALITY RATINGS.

As concomitant purposes of this investigation, the relationships between measures yielded by the three approaches to creativity and (a) intelligence, (b) achievement, and (c) teacher ratings of student personality were investigated.

Relationships Between IQ and Various Measures of Creative Ability

Table 54 summarizes the means and standard deviations of the verbal and non-verbal IQ scores yielded by the Lorge-Thorndike Intelligence Test for the total sample (N=129) and for Groups I (N=32) and II (N=24). It was observed that Group I had the higher means, but no significant differences at the .05 level in the means or standard deviations were found to exist between the two groups. National norms indicated a mean of 100 and a standard deviation of 16. Thus both groups were well above the national average. A comparison of group means with the means of the total sample indicated that Groups I and II were reasonably representative of that sample.

Approaches B and C. The Pearson product-moment correlation coefficients between verbal and non-verbal IQ scores yielded by the Lorge-Thorndike Intelligence Test and Approach B and MTCT, Abbr. Form VII measures are presented in Table 55. Very modest, but nevertheless statistically significant correlation coefficients, were found between intelligence measures and Approach B

Table 54

MEANS AND STANDARD DEVIATIONS OF VERBAL AND NON-VERBAL IQ FOR THE TOTAL SAMPLE, GROUPS I AND II

IQ		Total Sample (N=129)	Group I (N=32)	Group II (N=24)
Verbal	$\bar{X}$ =	108.9	112.6	106.8
	s =	14.1	12.4	16.4
Non-verbal	$\bar{X}$ =	112.6	116.2	110.3
	s =	14.7	13.3	15.3

measures for eleven of the sixteen correlation coefficients reported. It is notable that the lowest correlation coefficients existed between symbolic measures and intelligence measures. This finding was supported in a study by Burkhart, who reported insignificant correlations between intelligence test scores and art performance judgments.[110] Although symbolic creativity may be expressed in other ways than through aesthetic expression, the particular method of evaluation in Approach B was, to a large extent, designed to measure sensitivity to such qualities as might be exhibited in art performance.

The highest relationship was found between the figural measures of Approach B and verbal IQ. That "scientific" creativity is correlated modestly with intelligence is borne out in studies

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[110] R. C. Burkhart, "The Relationship of Intelligence to Art Abilities," Journal of Aesthetics and Art Criticism, 17 (December, 1958), 230-241.

Table 55

CORRELATION COEFFICIENTS† BETWEEN TWO MEASURES OF IQ AND APPROACH B AND C MEASURES OF CREATIVITY

N=129

Creative Abilities	Verbal IQ	Non-Verbal IQ
Specialized Performance Test Measures of Creativity (Approach B)		
Symbolic unusualness	-.12	.02
Symbolic creativity	-.03	.06
Figural unusualness	.28*	.25*
Figural creativity	.21*	.20*
Behavioral unusualness	.19*	.14
Behavioral creativity	.21*	.20*
Total unusualness	.20*	.24*
Total creativity	.24*	.27*
MTCT Measures (Approach C)		
Total non-verbal	.15	.21*
Total verbal	.08	.13
Grand total	.13	.20*
Total fluency	-.01	.10
Total flexibility	.13	.16
Total originality	.09	.16
Total elaboration	.26*	.25*
Total inventivlevel	.13	.15
Fluency, verbal	-.02	.06
Fluency, non-verbal	-.-1	.13
Flexibility, verbal	.09	.06
Flexibility, non-verbal	.09	.16
Originality, verbal	.07	.13
Originality, non-verbal	.05	.13
Elaboration, verbal	.28*	.22*
Elaboration, non-verbal	.21*	.21*

* Statistically significant at the .05 level.

† Pearson product-moment correlations.

by MacCurdy,[111] Barron and Taylor.[112] Although "scientific creativity" may cover a wide field, the nature of such creativity involves content which is in concrete form, as perceived or recalled in the form of images, and is therefore an approximation of the "figural" type of creativity evaluated in Approach B.

The observation that measures of total unusualness were correlated almost as highly with both verbal and non-verbal IQ as were measures of total creativity reinforces the hypothesis that the ability to produce unusual products may be highly related to producing creative products.

Approach B measures possessed a greater relationship with IQ measures than did Approach C measures, the latter evidencing only eight statistically significant correlation coefficients out of a total of 32 coefficients. Six of the eight statistically significant correlations were between measures of total elaboration, elaboration (verbal), and elaboration (non-verbal), and the two IQ measures. It will be recalled that MTCT measures of elaboration proved to be the best predictors of figural creativity for Approaches A and B. (See Tables 40 and 43.)

Approaches A, C and post-facto teacher ratings. Correlation coefficients between Approach A measures, post-facto teacher ratings and Approach C measures and two Lorge-Thorndike measures of intelligence are given in Table 56. The following observations are

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[111] R. D. MacCurdy, "Characteristics and Backgrounds of Superior Science Students," School Review, 64 (February, 1956), 67.

[112] F. Barron and C. W. Taylor (Ed.), Scientific Creativity, Its Recognition and Development, (New York, N. Y.: John Wiley and Sons, Inc., 1964), 386.

Table 56

CORRELATION COEFFICIENTS† BETWEEN TWO MEASURES OF IQ AND APPROACH A, C MEASURES AND POST-FACTO TEACHER RATINGS OF CREATIVITY[114]

Creative Abilities	Verbal IQ		Non-verbal IQ	
	Group I (N=32)	Group II (N=24)	Group I	Group II
Classroom Performance Measures of Creativity (Approach A)				
Figural unusualness	.40*	.52*	.30	.59*
Total unusualness	.38*	.49*	.36*	.61*
Figural creativity	.37*	.52*	.28	.52*
Total creativity	.34	.50*	.32	.55*
Post-Facto Teacher Ratings	.55*	.62*	.38*	.66*
MTCT Measures (Approach C)				
Total non-verbal	.16	.28	.14	.31
Total verbal	.07	.20	-.19	.35
Grand total	.13	.16	-.02	.39
Total fluency	-.02	.00	-.18	.25
Total flexibility	.02	.26	-.13	.30
Total originality	-.09	.17	-.11	.35
Total elaboration	.40*	.16	.25	.39
Total inventivlevel	.15	.17	.10	.34

* Significantly different from zero at the .05 level.

† Pearson product-moment correlations.

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[114] J. Moss, Jr., op. cit., 56.

evident: (a) A greater relationship was found between post-facto teacher ratings and IQ measures than between Approach C measures and IQ measures, (b) Like Approach B, the Approach A measures showed higher relationships to IQ than did Approach C (MTCT) measures, (c) Coefficients reported for Approach A were very similar, reflecting the similarity of creative (figural) content inherent in those measures.

The relatively high relationship observed between post-facto teacher ratings of creativity and IQ may indeed reflect some bias. Studies by Holland[113] and others give evidence of the fact that teachers tend to favor the intelligent pupils in their assessment of creative thinking abilities. The fact that Approach A measures might have been subject to somewhat the same biases may shed some light on the observed differences between the coefficients of Approaches A and B with IQ. It should, however, be emphasized once again that only Approach B figural measures are comparable with the four Approach A measures.

Relationships Between School Achievement and Various Measures of Creative Ability

Table 57 presents the means and standard deviations of the two types of school achievement used in this investigation, standardized achievement tests and teacher's grades. The percentiles of group means for achievement test scores are indicated for those measures where such data were available, based upon both local school district and national norms. The means for Group I

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[113] J. L. Holland, "Some Limitations of Teacher Ratings as Predictors of Creativity," op. cit., 222.

Table 57

MEANS,† STANDARD DEVIATIONS AND SOME PERCENTILES OF THE MEANS OF SCHOOL ACHIEVEMENT MEASURES

	Total Sample (N=129)	Group I (N=32)[115]			Group II (N=24)[116]		
School Achievement	$\bar{X}$ and s	$\bar{X}$ and s	Local Percentile	Nat'l Percentile	$\bar{X}$ and s	Local Percentile	Nat'l Percentile
Triggs Diagnostic Reading	$\bar{X}$ = 50.5	55.5*	62	68	$\bar{X}$ = 46.6	39	48
	s = 15.6	13.9	54	76	s = 17.7	40	67
STEP Social Studies	$\bar{X}$ = 47.8	50.0	47	67	$\bar{X}$ = 46.5	36	57
	s = 1.1	7.5*	80	--	s = 11.7	58	--
STEP Writing	$\bar{X}$ = 31.5	32.7	71	--	$\bar{X}$ = 29.7	64	--
	s = 9.3	7.9	--	--	s = 9.9	--	--
Snader General Math	$\bar{X}$ = 22.8	27.4*	--	--	$\bar{X}$ = 22.4	--	--
	s = 7.8	6.9	--	--	s = 8.3	--	--
Read General Science	$\bar{X}$ = 39.1	41.0	--	--	$\bar{X}$ = 38.4	--	--
	s = 10.9	10.7	--	--	s = 12.1	--	--
Avg. Ind. Arts Grade (7th and 8th)	$\bar{X}$ = 2.2	2.3	--	--	$\bar{X}$ = 2.2	--	--
	s = .6	.7	--	--	s = .7	--	--
Avg. English grade	$\bar{X}$ = 2.1	2.3	--	--	$\bar{X}$ = 2.0	--	--
	s = .8	.6	--	--	s = .8	--	--
Avg. Social Studies gr.	$\bar{X}$ = 2.1	2.3	--	--	$\bar{X}$ = 2.0	--	--
	s = .8	.7	--	--	s = 1.0	--	--
Avg. Math. grade	$\bar{X}$ = 2.1	2.4	--	--	$\bar{X}$ = 2.0	--	--
	s = .9	.8	--	--	s = .9	--	--
Avg. Ind. Arts grade (7th)	$\bar{X}$ = 2.2	2.4	--	--	$\bar{X}$ = 2.1	--	--
	s = .7	.7	--	--	s = .7	--	--
Avg. Science grade	$\bar{X}$ = 2.1	2.2	--	--	$\bar{X}$ = 2.0	--	--
	s = .8	.8	--	--	s = .8	--	--
Avg. Art grade	$\bar{X}$ = 2.3	2.3	--	--	$\bar{X}$ = 2.1	--	--
	s = .7	.8	--	--	s = .5	--	--
Avg. grade (7th)	$\bar{X}$ = 2.1	2.3	--	--	$\bar{X}$ = 2.0	--	--
	s = .7	.6	--	--	s = .7	--	--

*Significant differences in group means or variances at the .05 level; where variances were significantly different, group means were tested using the Welch approximation.

† Means of standardized tests are based on raw scores; means of teacher's grades are based on the scale of A=4, B=3, C=2, D=1, F=0.

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[115] J. Moss, Jr., *op. cit.*, p. 58

[116] *Ibid.*

were consistently higher than those for Group II and significant differences between group means were found for two of the measures. The difference in relative standing of the groups is indicated by the local and national percentiles of the means.

IQ and achievement. The objectives of this study were not expressly concerned with the relationships between IQ and achievement, however, Table 58 presents the correlation coefficients between the aforementioned measures in order that later comparisons might be made between such coefficients and those found to exist between creativity and achievement. All correlation coefficients between two types of achievement and verbal and non-verbal IQ for both groups, with one exception, were moderately high and statistically significant. Verbal IQ showed a closer relationship with achievement, in general, than did non-verbal IQ.

Approaches B, C and achievement tests. The correlation coefficients between standardized achievement tests and measures of creativity yielded by Approaches B and C are contained in Table 59. The following observations are offered: (a) symbolic unusualness and creativity appeared to be less related to achievement than were the figural and behavioral components of unusualness and creativity, (b) with the exception of elaboration scores, Approach C measures (MTCT) were not as highly related to standardized achievement as were Approach B measures, (c) IQ measures were apparently a better indicator of achievement than were either of the creativity measures.

Approaches A, C, post-facto teacher ratings and test achievement. The correlation coefficients between standardized achievement test scores and measures of creativity yielded by Approaches A, C

Table 58

CORRELATION COEFFICIENTS[†] BETWEEN VERBAL AND NON-VERBAL IQ AND VARIOUS MEASURES OF SCHOOL ACHIEVEMENT

	Total Sample (N=129)		Group I (N=32)	Group II (N=24)	Group I (N=32)	Group II (N=24)
School Achievement	Verbal IQ	Non-Verbal IQ	Verbal IQ	Verbal IQ	Non-Verbal IQ	Non-Verbal IQ
Triggs Diagnostic Reading	.75*	.48*	.63*	.83*	.48*	.51*
STEP Social Studies	.78*	.56*	.70*	.86*	.65*	.62*
STEP Writing	.71*	.55*	.70*	.80*	.49*	.60*
Snader General Mathematics	.65*	.62*	.56*	.67*	.68*	.67*
Read General Science	.76*	.56*	.76*	.83*	.64*	.47*
Avg. Ind. Arts Grade (7th and 8th)	.61*	.55*	.60*	.75*	.55*	.77*
Avg. English Grade	.62*	.42*	.49*	.75*	.35*	.59*
Avg. Social Studies Grade	.68*	.47*	.50*	.80*	.52*	.62*
Avg. Math. Grade	.69*	.67*	.74*	.75*	.71*	.77*
Avg. Ind. Arts Grade (7th)	.53*	.42*	.59*	.69*	.47*	.60*
Avg. Science Grade	.58*	.42*	.50*	.66*	.37*	.54*
Avg. Art Grade	.46*	.38*	.48*	.47*	.43*	.39*
Avg. Grade (7th)	.73*	.58*	.69*	.84*	.62*	.72*

* Significantly different from zero at the .05 level.

[†] Pearson product-moment correlations.

Table 59

CORRELATION COEFFICIENTS[†] BETWEEN STANDARDIZED ACHIEVEMENT TEST SCORES AND APPROACH B AND C MEASURES OF CREATIVITY FOR TOTAL SAMPLE (N=129)

Creative Abilities	Triggs Diagnostic Reading	STEP Social Studies	STEP Writing	Snader General Mathematics	Read General Science
Specialized Performance Test Measures (Approach B)					
Symbolic unusualness	-.07	-.10	-.08	-.07	-.13
Symbolic creativity	.01	-.02	.04	.07	-.01
Figural unusualness	.18*	.27*	.19*	.23*	.20*
Figural creativity	.18*	.22*	.11	.15	.17*
Behavioral unusualness	.20*	.22*	.26*	.16	.15
Behavioral creativity	.14	.20*	.24*	.16	.12
Total unusualness	.18*	.22*	.21*	.19*	.12
Total creativity	.23*	.24*	.21*	.23*	.18*
MTCT Measures (Approach C)					
Total non-verbal	.10	.18*	.02	.08	.13
Total verbal	-.03	-.02	.05	.06	.06
Grand total	.04	.09	.04	.08	.11
Total fluency	-.11	-.06	-.02	.02	-.04
Total flexibility	.00	.10	.03	.08	.11
Total originality	-.02	.07	.00	.02	.10
Total elaboration	.24*	.23*	.12	.16	.20*
Total inventivlevel	.08	.12	.14	.05	.15
Fluency, verbal	-.13	-.12	-.04	-.01	-.05
Fluency, non-verbal	-.05	.05	-.03	.04	-.03
Flexibility, verbal	-.04	-.02	.06	.02	.07
Flexibility, non-verbal	.01	.14	-.03	.05	.08
Originality, verbal	-.02	.01	.05	.03	.09
Originality, non-verbal	-.03	.13	-.10	.01	.06
Elaboration, verbal	.22*	.26*	.19*	.23*	.17*
Elaboration, non-verbal	.20*	.17*	.07	.10	.17*

* Significantly different from zero at the .05 level.

[†] Pearson product-moment correlations.

and post-facto teacher ratings are shown in Table 60 for Groups I and II. It is observed that post-facto teacher ratings of creativity were significantly (.05) related to all measures of school achievement for Groups I and II. Slightly lower relationships were noted between Approach A measures and achievement, with Group II correlation coefficients somewhat higher than those reported for Group I.

A comparison of the coefficients in Tables 56 and 60 indicates that Approach A and C measures held approximately the same relationship to IQ as to achievement. It is notable, however, that a greater relationship existed between achievement and IQ, especially verbal IQ, than with creativity measures, especially those yielded by Approach C.

Approaches B, C and teachers' grades. Contained in Table 61 are correlation coefficients between school achievement, as measured by teachers' grades, and Approach B and C measures of creative ability. The findings, in general, are quite similar to those findings relating creativity measures and standardized achievement test measures in Table 59. Three Approach B measures, figural unusualness, figural creativity, and total creativity, and the three Approach C measures of elaboration showed the greatest relationships with teacher grade measures. It is notable that Approach B symbolic creativity measures, although statistically insignificant, evidenced a higher correlation with industrial arts and art grades than with any other subject area grade; both curriculum areas give some emphasis to symbolism of an aesthetic sort.

Table 60

CORRELATION COEFFICIENTS† BETWEEN STANDARDIZED ACHIEVEMENT TEST MEASURES AND APPROACH A, C MEASURES AND POST-FACTO TEACHER RATINGS OF CREATIVITY FOR GROUPS I AND II[117]

Group I (N=32), Group II (N=24)

Creative Abilities	Triggs Diagnostic Reading		STEP Social Studies		STEP Writing		Snader General Mathematics		Read General Science	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
Classroom Performance Measures of Creativity (Approach A)										
Figural unusualness	.33	.50*	.46*	.40	.46*	.50*	.30	.64*	.29	.47*
Total unusualness	.32	.55*	.46*	.40	.48*	.45*	.30	.67*	.31	.46*
Figural creativity	.35*	.48*	.46*	.42*	.47*	.48*	.34	.62*	.29	.50*
Total creativity	.34	.52*	.47*	.43*	.50*	.46*	.33	.64*	.32	.49*
Post-Facto Teacher Ratings	.55*	.52*	.45*	.47*	.51*	.57*	.42*	.59*	.56*	.51*
MTCT Measures (Approach C)										
Total non-verbal	.04	.00	.16	.21	-.07	.17	.12	.24	.02	-.07
Total verbal	-.19	.13	-.05	.21	.04	.27	-.11	.60*	-.01	.23
Grand total	-.09	.07	.07	.25	-.02	.25	.01	.48*	.00	.08
Total fluency	-.21	-.06	-.08	.11	.02	.14	.00	.38	-.07	.00
Total flexibility	-.19	.15	-.12	.34	-.10	.26	-.09	.44*	-.06	.23
Total originality	-.31	.07	-.07	.25	-.10	.23	-.23	.40	-.17	.16
Total elaboration	-.29	.11	.33	.28	.04	.24	.24	.43	.23	-.03
Total inventivlevel	-.04	.16	.11	.21	.12	.29	.04	.56*	.01	.21

* Significantly different from zero at the .05 level.

† Pearson product-moment correlations.

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[117] J. Moss, Jr., *op. cit.*, 60.

Table 61

CORRELATION COEFFICIENTS† BETWEEN TEACHER'S GRADES AND APPROACH B AND C MEASURES OF CREATIVITY FOR TOTAL SAMPLE (N=129)

Creative Abilities	Avg. I.A. (7 and 8)	Avg. English	Avg. Soc. St.	Avg. Math.	Avg. I.A. (7)	Avg. Science	Avg. Art	Avg. 7th Grade
Specialized Performance Test Measures (Approach B)								
Symbolic unusualness	.06	-.14	-.11	-.03	.09	-.09	.00	-.07
Symbolic creativity	.13	-.02	-.01	.07	.16	.01	.12	.07
Figural unusualness	.29*	.17*	.28*	.34*	.23*	.19*	.26*	.29*
Figural creativity	.32*	.19*	.29*	.29*	.28*	.11	.14	.29
Behavioral unusualness	.10	.23*	.19*	.13	.02	.18*	.11	.16
Behavioral creativity	.11	.26*	.26*	.20*	.09	.22*	.08	.24
Total unusualness	.26*	.15	.20*	.26*	.20*	.15	.22*	.22*
Total creativity	.36*	.24*	.31*	.32*	.32*	.19*	.20*	.35*
MTCT Measures (Approach C)								
Total non-verbal	.09	.08	.10	.14	.09	.06	.05	.09
Total verbal	.05	.14	.01	.10	.07	.01	.10	.08
Grand total	.08	.13	.07	.14	.09	.04	.08	.08
Total fluency	-.03	.05	-.04	.03	.01	-.08	.06	-.04
Total flexibility	.08	.15	.09	.16	.07	.08	.05	.09
Total originality	.03	.08	-.01	.10	.04	-.02	.00	.03
Total elaboration	.20*	.19*	.21*	.21*	.19*	.19*	.17*	.23*
Total inventivlevel	.09	.06	-.03	.08	.10	.01	.05	.02
Fluency, verbal	-.02	.06	-.05	.02	.04	-.08	.09	-.04
Fluency, non-verbal	-.02	.05	.02	.03	-.03	-.05	-.05	-.02
Flexibility, verbal	.12	.14	.08	.11	.13	.04	.09	.10
Flexibility, non-verbal	.02	.06	.04	.11	.01	.04	-.03	.03
Originality, verbal	.02	.12	-.01	.11	.03	.01	.03	.05
Originality, non-verbal	.01	-.01	.03	.05	.01	-.05	-.05	-.02
Elaboration, verbal	.18*	.28*	.22*	.21*	.10	.24*	.19*	.28*
Elaboration, non-verbal	.17*	.13	.18*	.17*	.18*	.13	.13	.18*

* Significantly different from zero at the .05 level.

†Pearson product-moment correlations.

Approaches A, C, post-facto teacher ratings and teachers' grades. Table 62 summarizes the correlation coefficients between school achievement, as measured by teachers' grades, and Approach A, C measures and post-facto teacher ratings of creative ability. These findings were quite similar to those coefficients found with standardized achievement test measures reported in Table 60. Coefficients between post-facto teacher ratings of creative abilities and teacher grades were somewhat higher than coefficients between Approach A measures of creativity and teacher grades. Both sets of measures were, however, significant or approaching significance. With few exceptions, notably elaboration, MTCT measures were not significantly related to teacher grades. Group II coefficients were generally higher than were those resultant from Group I measures.

A summary of the data presented in this section suggests that

(a) The highest relationships between creative abilities and achievement were found by Approach A. Approach B measures had a lower relationship but, of these, figural content did relate best.

(b) Approach C measures of creativity, except for elaboration, showed little relationship to either type of achievement measures.

(c) Approaches A, B and C measures of creativity tended to correlate approximately equally with both types of achievement measures.

(d) Approaches A, B, and C measures of creativity were each related about equally to IQ and achievement.

(e) IQ was a better indicator of achievement that was any of the three creativity measures.

Table 62

CORRELATION COEFFICIENTS† BETWEEN TEACHER'S GRADES AND APPROACH A, C MEASURES AND POST-FACTO TEACHER RATINGS OF CREATIVITY FOR GROUPS I (N=32) AND II (N=24)[118]

Creative Abilities	Avg. I. A. (7 & 8)		Avg. English		Avg. Soc. St.		Avg. Math		Avg. I.A. (7)		Avg. Science		Avg. Art		Avg. 7th Grade	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
Figural unusualness	.51*	.62*	.36*	.51*	.35*	.47*	.36*	.56*	.52*	.45*	.30	.60*	.16	.55*	.47*	.59*
Figural creativity	.47*	.63*	.31	.39	.27	.37	.36*	.48*	.46*	.47*	.32	.52*	.23	.52*	.42*	.50*
Total unusualness	.53*	.60*	.38*	.50*	.36*	.50*	.38*	.53*	.54*	.45*	.36*	.64*	.18	.56*	.50*	.59*
Total creativity	.50*	.61*	.33	.41*	.29	.44*	.36*	.47*	.49*	.46*	.39*	.60*	.23	.56*	.44*	.54*
Post-Facto Teacher Ratings	.76*	.70*	.58*	.54*	.54*	.71*	.63*	.69*	.76*	.53*	.40*	.69*	.53*	.42*	.75*	.72*
MTCT non-verbal	.24	.02	.29	.08	.34	.01	.19	.09	.23	.00	-.08	.26	.04	.38	.28	.10
MTCT verbal	.00	.29	.10	.33	.06	.19	.09	.38	.07	.16	-.31	.33	-.35*	.56*	.08	.33
MTCT grand total	.15	.17	.23	.23	.24	.11	.17	.27	.18	.09	-.22	.34	-.17	.54*	.21	.24
MTCT fluency	-.02	.03	.07	.15	.11	-.05	.09	.13	.01	-.07	-.36*	.16	-.34	.41*	.06	.08
MTCT flexibility	.00	.28	.11	.24	.11	.18	.08	.29	-.04	.24	-.13	.31	-.15	.51*	.06	.29
MTCT originality	-.07	.15	.03	.21	-.03	.14	-.05	.24	.02	.03	-.36*	.28	-.39*	.41*	-.05	.22
MTCT elaboration	.44*	.18	.46*	.19	.49*	.15	.35*	.27	.47*	.14	.09	.40	.24	.52*	.51*	.26
MTCT inventivlevel	.17	.24	.13	.30	.05	.14	.09	.31	.21	.12	-.19	.32	-.16	.55*	.11	.28

* Significantly different from zero at the .05 level.

† Pearson product-moment correlations.

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[118] J. Moss, Jr., *op. cit.*, 61.

Relationships Between Personality Ratings and Various Measures of Creative Ability

Table 63 presents the means and standard deviations of the seven measures yielded by the personality grading scale for the total sample, Group I and Group II. No significant differences were found between groups on any measure. Groups I and II appear to be representative of the total sample.

Achievement, IQ and Personality ratings. As a matter of interest, the correlation coefficients between measures of personality and achievement and IQ measures are contained in Table 64.

Table 63

MEANS AND STANDARD DEVIATIONS OF PERSONALITY MEASURES FOR THE TOTAL SAMPLE, GROUPS I AND II

Personality Trait		Total Sample (N=129)	Group I (N=32)	Group II (N=24)
Self confidence	$\bar{X}$ =	5.11*	5.20	5.21
	s =	1.51	1.40	1.55
Temperament	$\bar{X}$ =	5.26	5.36	5.25
	s =	1.07	1.29	1.16
Sociability	$\bar{X}$ =	4.98	5.30	4.67
	s =	1.31	1.23	1.63
Masculinity	$\bar{X}$ =	4.88	5.25	4.90
	s =	.96	.89	1.03
Impulsiveness	$\bar{X}$ =	4.78	4.80	4.94
	s =	1.51	1.44	1.75
Courtesy	$\bar{X}$ =	5.43	5.47	5.58
	s =	1.51	1.30	2.02
Cooperation	$\bar{X}$ =	5.36	5.53	5.52
	s =	1.45	1.26	1.92

* Based on a 1 to 10 scale.

Table 64

CORRELATION COEFFICIENTS[†] BETWEEN MEASURES OF PERSONALITY AND MEASURES OF ACHIEVEMENT AND IQ FOR THE TOTAL SAMPLE

N=129

Achievement and IQ Measures	Self-confidence	Temperament	Sociability	Masculinity	Impulsiveness	Courtesy	Cooperation
Grades in the 7th Grade							
Avg. I.A. (7 & 8)	.49*	.45*	.34*	.28*	.51*	.57*	.64*
Avg. English	.22*	.21*	.13	.05	.51*	.45*	.41*
Avg. Soc. Studies	.31*	.32*	.20*	.13	.56*	.53*	.54*
Avg. Math.	.40*	.32*	.26*	.17*	.57*	.51*	.55*
Avg. I.A. (7)	.35*	.36*	.24*	.25*	.38*	.46*	.50*
Avg. Science	.32*	.22*	.16	.04	.47*	.43*	.43*
Avg. Art	.28*	.28*	.19*	.20*	.39*	.44*	.41*
Avg. 7th Grade	.39*	.38*	.25*	.18*	.58*	.57*	.58*
Achievement Test Measures							
Triggs Diag. Reading	.41*	.31*	.29*	.11	.50*	.43*	.50*
STEP Soc. Studies	.34*	.19*	.19*	.05	.47*	.38*	.44*
STEP Writing	.39*	.29*	.23*	.15	.53*	.47*	.53*
Snader Gen. Math.	.32*	.31*	.24*	.14	.47*	.43*	.47*
Read Gen. Science	.48*	.32*	.27*	.07	.49*	.40*	.48*
IQ							
Verbal IQ	.40*	.38*	.31*	.12	.58*	.49*	.57*
Non-verbal IQ	.43*	.30*	.33*	.20*	.48*	.38*	.49*

* Statistically significant from zero at the .05 level.

[†] Pearson product-moment correlations.

The important findings may be summarized as follows: (a) The highest relationships were found to exist between measures of cooperation, courtesy and impulsiveness, and measures of IQ and achievement. (b) Modest, but statistically significant correlation coefficients were also found between measures of self confidence, sociability and temperament, and most measures of IQ and achievement. (c) When total seventh grade average achievement was considered, the cooperative, cautious and calculating, well mannered, self-confident student tended to receive better grades than fellow students who did not rank as high on such characteristics.

Approaches B, C and personality ratings. Correlation coefficients between Approach B and C measures of creativity and teacher perceptions of student personality for the total sample are contained in Table 65. Despite the sterotyped notion that creative adults tend to be eccentric and anti-social, sociability and creativity measures showed a greater positive relationship than was evidenced for any of the other traits of personality reported in the table. A moderate, but nevertheless statistically significant positive relationship (.05) between "sociability" and measures of creativity was found for six out of eight Approach B measures and for twelve out of sixteen Approach C measures. With the exception of flexibility and elaboration, Approach C measures were negatively related to "courtesy". It is suggested that the more creative student actively seeks social pleasures, but in his social relationships he does not exhibit a great concern for courtesy as interpreted by adult standards.

Table 65

CORRELATION COEFFICIENTS[†] BETWEEN APPROACH B AND C MEASURES OF CREATIVITY AND TEACHER RATINGS OF STUDENT PERSONALITY FOR THE TOTAL SAMPLE

(N=129)

Creative Abilities	Self-confidence	Temperament	Sociability	Masculinity	Impulsiveness	Courtesy	Cooperation
Specialized Performance Test Measures (Approach B)							
Symb. unusualness	.11	-.03	.17*	.16	.01	-.06	.04
Symb. creativity	.12	.00	.17*	.18*	.01	-.04	.00
Fig. unusualness	.29*	.26*	.32*	.14	.21*	.21*	.25*
Fig. creativity	.27*	.23*	.27*	.18*	.18*	.14	.23*
Behav. unus.	.13	.08	.08	.06	.15	.17*	.21*
Behav. creativity	.01	-.02	.01	.05	.09	.06	.13
Total unus.	.30*	.17*	.32*	.20*	.21*	.18*	.28*
Total creativity	.29*	.16	.29*	.23*	.20*	.15	.25*
MTCT Measures							
Total non-verbal	.03	.10	.18*	.04	.13	-.02	.12
Total verbal	.02	.14	.28*	.13	.06	-.03	.12
Grand total	.03	.13	.26*	.10	.11	-.03	.14
Total fluency	-.09	.09	.20*	.11	-.02	-.09	.02
Total flexibility	.01	.15	.22*	.08	.16	.03	.19*
Total originality	.01	.06	.21*	.06	.08	-.08	.11
Total elaboration	.16	.16	.25*	.10	.20*	.06	.20*
Total inventiv-level	-.01	.18*	.28*	.09	-.06	-.13	.06
Fluency, verbal	-.04	.11	.25*	.13	-.03	-.09	.03
Fluency, non-verbal	-.14	.05	.07	.03	.02	-.05	.02
Flexibility, verbal	.03	.17	.29*	.17*	.12	.11	.21*
Flexibility, non-verbal	-.03	.10	.10	-.01	.10	-.02	.13
Origin., verbal	.01	.06	.21*	.09	.08	-.06	.10
Origin., non-verbal	-.02	.03	.11	-.02	.04	-.10	.04
Elaboration, verbal	.20*	.17*	.14	.05	.12	.18*	.23*
Elaboration, non-verbal	.13	.15	.26*	.10	.19*	.38*	.16

* Significantly different from zero at the .05 level.

† Pearson product-moment correlations.

The fact that measures of figural unusualness and total unusualness (Approach B) showed statistically significant relationships with nearly all measures of personality suggests that the junior high school student with unusual ideas, particularly those of a figural nature, tends also to possess more desirable traits of personality than his less ingeneous peers.

Four creativity approaches, Groups I and II and personality ratings. Contained in Table 66 are the correlation coefficients between teacher perceptions of student personality and four measures of creativity for Groups I and II. The following observations are offered: (a) Post-facto teacher ratings of creativity showed higher relationships with teacher ratings of student personality than did measures obtained from Approaches A, B or C. The biases of teacher ratings may be contributing to this high relationship. To a lesser extent, coefficients between Approach A measures and measures of personality may reflect these same biases. (b) Approach B symbolic and behavioral measures tended to show insignificant correlations with measures of personality, while figural creativity tended to relate positively and significantly. (c) Only the Approach C measures of elaboration appeared to have a generally positive, statistically significant relationship with measures of personality. (d) In these two small groups, sociability was not clearly associated with creativity.

Table 66

CORRELATION COEFFICIENTS† BETWEEN FOUR MEASURES OF CREATIVITY AND TEACHER RATINGS OF STUDENT PERSONALITY FOR GROUPS I AND II

Group I (N=32), Group II (N=24)

Creative Abilities	Self-Confidence		Temperament		Sociability		Masculinity		Impulsiveness		Courtesy		Cooperation	
	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II	Group I	Group II
Classroom Performance Measures (Approach A)														
Figural unusualness	.40*	.68*	.39*	.65*	.25	.62*	.16	.44*	.52*	.63*	.42*	.61*	.37*	.76*
Total unusualness	.48*	.69*	.40*	.64*	.29	.60*	.21	.44*	.48*	.64*	.42*	.60*	.36*	.76*
Figural creativity	.47*	.68*	.42*	.59*	.31	.60*	.17	.37*	.56*	.70*	.44*	.59*	.39*	.81*
Total creativity	.53*	.69*	.40*	.60*	.32	.58*	.22	.39*	.49*	.69*	.42*	.59*	.36*	.81*
Specialized Performance Test Measures (Approach B)														
Symbolic unusualness	-.14	.01	-.19	.09	-.07	.15	-.05	.14	-.24	-.04	-.23	-.40*	-.18	-.09
Symbolic creativity	.11	-.18	-.07	-.07	.10	.02	.01	.19	-.09	-.09	-.13	-.21	-.15	-.11
Figural unusualness	.37*	.13	.47*	.17	.45*	.27	.15	.44*	.33	.08	.43*	.28	.39*	.09
Figural creativity	.44*	.10	.38*	.30	.33	.28	.15	.41*	.44*	.02	.58*	.18	.52*	.07
Behavioral unusualness	-.11	.24	-.36*	.12	-.18	.04	.21	-.06	-.26	.15	-.20	.39	-.15	.16
Behavioral creativity	.02	.06	-.24	.00	-.10	-.09	.11	-.47*	-.11	.37	-.01	.47*	.00	.32
Total unusualness	.09	.31	.02	.30	.13	.36	.19	.43*	-.07	.11	.03	.17	.06	.09
Total creativity	.35*	-.05	.14	.17	.24	.19	.16	.20	.21	.07	.30	.13	.26	.08

Table 66 (continued)

CORRELATION COEFFICIENTS† BETWEEN FOUR MEASURES OF CREATIVITY AND TEACHER RATINGS OF STUDENT PERSONALITY FOR GROUPS I AND II

Group I (N=32), Group II (N=24)

Creative Abilities	Self-Confidence Group I	Self-Confidence Group II	Temperament Group I	Temperament Group II	Sociability Group I	Sociability Group II	Masculinity Group I	Masculinity Group II	Impulsiveness Group I	Impulsiveness Group II	Courtesy Group I	Courtesy Group II	Cooperation Group I	Cooperation Group II
MTCT Measures (Approach C)														
Total non-verbal	.07	.18	.43*	-.03	.29	.09	.15	.03	.29	.12	.27	.04	.31	.11
Total verbal	-.02	.24	.18	.27	.06	.24	.00	.13	-.09	.39	-.13	.23	-.08	.43*
Grand total	.03	.27	.36*	.13	.21	.19	.09	.09	.13	.29	.09	.10	.14	.30
Total fluency	-.01	.09	.26	-.02	.11	.05	.06	.01	-.08	.17	-.14	.04	-.09	.19
Total flexibility	-.03	.33	.32	.10	.18	.16	.02	.02	.10	.37	.10	.12	.11	.32
Total originality	.12	.27	.16	.07	.05	.13	-.04	.04	-.09	.36	-.15	.09	-.07	.34
Total elaboration	.20	.28	.42*	.24	.33	.27	.19	.19	.42*	.16	.43*	.10	.45*	.23
Total inventivlevel	.04	.25	.15	.26	.05	.21	.07	.16	-.03	.34	-.06	.32	.00	.45*
Fluency, verbal	-.01	.06	.20	.02	.09	.08	.04	.04	-.10	.21	-.20	.06	-.13	.23
Fluency, non-verbal	-.02	.09	.27	-.09	.11	.02	.08	-.07	.02	.02	.07	-.02	-.05	.03
Flexibility, verbal	.09	.38	.14	.23	.27	.23	.27	.13	.02	.40	-.03	.21	.02	.36
Flexibility, non-verbal	-.11	.15	.22	-.07	.18	.02	.17	-.12	.01	.20	.04	-.02	.10	.15
Originality, verbal	-.11	.26	.06	.21	-.06	.18	-.12	.09	-.12	.39	-.15	.20	-.09	.42*
Origin., non-verbal	-.05	.12	.11	-.19	.19	-.04	.20	.07	-.03	.09	-.12	-.19	-.03	-.01
Elaboration, verbal	.06	.41*	.01	.62*	.15	.42*	.28	.24	-.04	.31	.09	.39	.11	.42*
Elabor., non-verbal	.16	.72	.40*	.12	.21	.23	.00	.20	.44*	.12	.43*	.00	.41*	.15
Post-Facto Teacher Ratings of Creativity	.72*	.87*	.73*	.79*	.64*	.81*	.60*	.50*	.56*	.77*	.45*	.60*	.49*	.83*

* Statistically different from zero at the .05 level.

† Pearson product-moment correlations.

CHAPTER VI

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

The principal purpose of this study was to estimate the concurrent validity of the Minnesota Tests of Creative Thinking, Abbr. Form VII, by determining the relationships of its measures to criterion measures based upon specialized performance tests of industrial arts creativity developed by the investigator. A secondary objective was to determine the relationships between measures of creative abilities based upon accumulated teacher ratings of observed student behavior as they occurred in typical industrial arts classes and those acquired through the use of the investigator's instruments.

Other concomitant purposes of this study were to estimate the relationships among measures of creative abilities in industrial arts as determined by (1) teacher ratings of actual performance in industrial arts classes accumulated over a period of time (Approach A), (2) the investigator's specialized performance test approach (Approach B), (3) the Minnesota Tests of Creative Thinking, Abbr. Form VII (Approach C), and

a. standardized measures of intelligence.
b. the teacher's perception of certain selected student personality characteristics.
c. school achievement based upon teacher's grades.
d. scores from certain standardized achievement tests.

The population-sample included 129 eighth grade boys receiving instruction in industrial arts in two suburban St. Paul, Minnesota junior high schools. A specialized performance test (Approach B) of industrial arts creativity was administered during the period of time in which another investigator measured the creative abilities of the same students through observation of classroom performance (Approach A), and obtained MTCT, Abbr. Form VII measures (Approach C). Descriptive data for the sample, gathered from cumulative records, included (a) verbal intelligence scores, (b) non-verbal intelligence scores, (c) average grades in seventh grade English, social studies, mathematics, industrial arts and art, (d) standardized achievement test scores in reading, mathematics, social studies, writing and science. In addition, cooperating industrial arts teachers completed a graphic personality rating scale for each student participating in the study.

According to the definition of relative creative abilities accepted for this study, (a) a student's creative abilities are evidenced by the relative degree of unusualness and usefulness of the student's products (overt behavior) and (b) creative behavior may be categorized as figural, behavioral and symbolic, according to the nature of the idea inherent in the behavior. Basing a scoring system upon the guidelines set forth by this definition, Approach A scores were derived for figural unusualness, total unusualness, figural creativity and total creativity. Working from the same definition, separate Approach B scores were obtained for symbolic unusualness, symbolic creativity, figural unusualness, figural creativity, behavioral unusualness, behavioral creativity, total unusualness, and total creativity. MTCT, Abbr. Form VII (Approach C) measures were obtained for total verbal, total nonverbal, grand total, total fluency, total flexibility, total originality, total elaboration, total inventivlevel, and both verbal and non-verbal measures of fluency, flexibility, originality and elaboration. The personality grading scale yielded scores for self confidence, temperament, sociability, masculinity, impulsiveness, courtesy and cooperation.

Pearson product-moment correlational techniques were employed to estimate the concurrent validity of the MTCT, Abbr. Form VII, as well as the relationships between measures of creative abilities, IQ, achievement and personality.

Multiple linear regression equations were formulated in order to provide evidence of the degree to which a best weighted combination of variables from the MTCT, Abbr. Form VII would predict criterion measures of creative abilities.

Conclusions

Eight major hypotheses formed the framework for this study. The conclusions relating to each hypothesis are summarily stated here, along with a brief recapitulation of relevant findings. The conclusions of this study are limited to the particular sample utilized. Application of these conclusions to other groups of students must be done with extreme caution.

The hypotheses tested and the results obtained follow.

H_1 There are no significant relationships between sets of measures of creative abilities as obtained by specialized performance tests (Approach B) and the MTCT, Abbr. Form VII (Approach C).

Only nineteen out of a total of 128 reported correlation coefficients were statistically significant at the .05 level. This finding suggests that Approaches B and C were generally not measuring identical elements of creative abilities. Low, but statistically significant relationships were found between elaboration (Approach C) and both figural and behavioral creativity (Approach B). This suggests that a facility for supplying detail and supporting ideas on a paper and pencil test may be slightly indicative of creative behavior which is exhibited through the manipulation of tools and materials and through interpersonal relationships.

H_2 There are no significant relationships between sets of measures of creative abilities as obtained by teacher ratings of observed behavior in the classroom (Approach A) and specialized performance tests (Approach B).

Because Approach A was purported to yield measures of figural creativity, any comparisons made between the two approaches must be limited to the two figural measures yielded by Approaches B and A. A generally low relationship between such measures was observed; only one correlation was found to be statistically significant. Aside from errors in measurement, other possible explanations for the lack of strong relationships between such measures may be differences (a) in the nature of the measurement situation, (b) in motivational influences, and (c) in the substantive content of the problem tasks.

H_3 There are no significant relationships among sets of creative abilities involved in behavioral, symbolic and figural content, as measured by specialized performance tests (Approach B).

A generally low relationship was observed among measures of symbolic, figural and behavioral creativity. However, moderate to high relationships observed between unusualness and creativity measures in each content area suggests that the facility to generate unusual ideas may be accompanied by the ability to produce useful products.

H_4 There are no significant relationships between sets of creative abilities as measured by Approaches A, B, and C, and teacher ratings of selected student personality characteristics.

Moderate, significant, positive relationships were reported between all Approach A measures and each of the seven personality ratings. These relationships may reflect, to some degree, teacher biases resulting from certain halo effects; however, Approach B, figural and total creativity measures also revealed statistically significant relationships with nearly all measures of personality. This suggests that the junior high school student with unusual and useful ideas, particularly those of a figural nature, tends to possess more desirable traits of personality than his less creative peers. Relationships evidenced between Approach C measures and personality ratings suggest that the more social student also tends to be more creative.

H_5 There are no significant relationships between creative thinking abilities as measured by Approach B and selected standardized achievement test scores.

Relationships between figural and total creativity (Approach B) and standardized achievement test measures were generally modest, but statistically significant. Behavioral creativity tended to have less of a relationship, and symbolic creativity was not at all related to measures of standardized achievement.

H_6 There are no significant relationships between sets of creative abilities as measured by Approach B and teacher grades in selected subject areas.

The pattern of relationships was quite similar to that reported for the relationships between creativity and standardized achievement test measures, except that nearly all coefficients were slightly higher. Figural and total creativity yielded the highest relationship with teacher grades. Although 33 out of a total of 64 reported correlation coefficients between Approach B measures and teacher grades were statistically significant, those relationships, at best, could only be classified as being rather modest.

H_7 There are no significant relationships between creative abilities as measured by Approach B and intelligence as measured by a standardized test.

Findings suggested that both verbal and non-verbal intelligence measures appeared to have a significant but low (.19 to .28) relationship to specialized performance test measures of figural and behavioral creativity, but insignificant relationships with measures of symbolic creativity.

H_8 Combinations of measures yielded by the MTCT, Abbr. Form VII (Approach C) are not significant predictors of criterion measures yielded by specialized performance test scores (Approach B).

Significant coefficients were found only between combinations of Approach C measures and (a) figural unusualness, (b) figural creativity, (c) behavioral creativity, and (d) total unusualness. The significant coefficients, however, ranged from .36 to .38 and suggest that Approach C measures are poor predictors of criterion measures.

Implications

Evidence gathered in this investigation has suggested several implications for industrial arts educators and researchers.

1. The findings of this study suggest that the MTCT, Abbr. Form VII paper and pencil tests of creativity may be measuring other factors than are required by students in the creative performance of industrial arts related tasks. It is therefore speculated that "creative thinking" which gains expression through problems involving specific industrial arts related subject matter may be tapping different or additional characteristics than the "creative thinking" involved in responding to the non-specialized content of paper and pencil tests. Further research in developing instruments which seek to measure creative performance in

industrial arts environments is recommended.

2. The fact that high, significant relationships were not discovered between figural creativity as expressed in a typical performance situation and figural creativity as measured by a specialized performance test suggests that far more attention need be given to the motivational and substantive aspects of creative performance. The time has come for researchers to distinguish between creativity scores representing what the student is able to do and scores which indicate what he actually does. The student's real capabilities may very well be dependent upon the degree to which he is motivated. Conditions which tend to motivate or inhibit, free or freeze the individual should be taken into account in the evaluation of creative performance. Confusion over this issue may have rather profound effects on the interpretation of creativity data.

3. Findings of this study indicate a relative independence of figural, behavioral and symbolic types of creative behavior. Industrial educators may be wise to use the word "creativity" with caution, for without proper qualification, reference to creative production becomes quite ambiguous. The artistic student who can express creative talent in an article of aesthetic beauty may not necessarily be capable of planning a creative approach to a machine production problem or to a situation which calls for unusual and usual interpersonal relationships.

4. This study supports findings by several investigators which point to a low or insignificant relationship between test measures of creativity and IQ for an above average IQ population. If this relative independence does exist, then it becomes imperative that practical instruments need to be developed which better identify the specific elements of creative performance. In order to evaluate the relative effect of teaching methods designed to promote creative thinking in the industrial arts laboratory, it is essential to identify the nature of creative performance which is being measured. Hence a need is evidenced for a further refinement of our present instruments.

5. The findings of this investigation have supported the supposition that certain positive relationships do exist between traits of personality and creative thinking. Studies by Beach[119] and others have already confirmed that learner productivity may be substantially increased when attention is given to matching teaching method with selected attributes of personality. If the "creative personality" is indeed a reality, then investigations should be conducted which seek to discover more about the manner in which creative students learn, with implications for appropriate teaching methods.

6. It was notable that IQ measures, particularly verbal IQ, proved to be better indicators of achievement than were measures

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[119] L. R. Beach, "Sociability and Academic Achievement in Various Types of Learning Situations," Journal of Educational Psychology, (August, 1960), 208-212.

yielded by the three creativity approaches. This finding suggests that both standardized achievement tests and teachers' grades may reflect the premium placed upon a convergent, conforming type of thinking in the classroom. A need is evidenced for a fuller meaning of "achievement" to include creative as well as strictly intellectual performance.

7. An interesting finding in this study was the relatively high relationship observed between unusualness and creativity within Approach B content categories. This finding suggests that the ability to produce unusual products may be closely related to the ability to produce useful products. The fact that Moss[120] has reported similar findings, using a different evaluation method, casts a new light upon the predictive nature of unusualness as a factor in total creativity, and suggests a new and different research approach for use in future investigations.

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[120] J. Moss, Jr., op. cit.

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APPENDICES

APPENDIX A

Personality Grading Scale

PERSONALITY GRADING SCALE

Student ____________________ Instructor ____________________

Course ____________________ Date ____________________

This scale is to be completed by each instructor for every one of his students at the conclusion of the quarter. Definitions for the characteristics are given below. Ratings of 0 through 10 should be based on observed behavior, and keyed to the scale given for each characteristic. Insufficient evidence for proper rating of any given characteristic may be indicated in the column "Not Graded."

Definitions:

(1) Self-confidence: Confidence in one's own judgment, ability and power.
(2) Temperament: Frame of mind or state of feeling as evidenced by one's speech and action.
(3) Sociability: Disposition or inclination for the company of other students.
(4) Masculinity: Displaying of masculine qualities.
(5) Impulsiveness: Tendency toward emotional or involuntary impulses.
(6) Courtesy: Degree of politeness in manners or behavior.
(7) Cooperation: Willingness to share in activities for mutual benefit.
(8) Flexibility: Willingness to adapt to a different point of view.

Characteristic	Scale					Grade	Not Graded
	0 1	2 3	4 5	6 7	8 9 10		
Self-Confidence	Painfully self-conscious	Timid, frequently embarrassed	Self-conscious on occasions	Self-reliant, confident in himself	Bold, insensitive to social feelings		
Temperament	Dejected, melancholic, in the dumps	Generally dispirited	Unually in good humor	Animated, cheerful	Hilarious, buoyant		
Sociability	Lives almost entirely by himself	Follows few social activities	Pursues usual social activities	Actively seeks social pleasures	Prefers social activities to all else		
Masculinity	Is a sissy	Slightly effeminate	Has average boy qualities	Very masculine	Entirely masculine "A buck"		
Impulsiveness	Impulsive, bolts, acts on the spur of the moment	Frequently unreflective and impudent	Acts with reasonable care	Deliberate	Very cautious and calculating		
Courtesy	Manners often somewhat crude, sometimes definitely offensive	Only rarely impolite or disrespectful	Generally polite and respectful	Generally refined and well mannered	Manners demonstrate natural grace and refinement		
Cooperation	Does not have agreeable working relationships with others	Sometimes evidences a lack of cooperation	Generally cooperative	Evidences a greater degree of cooperation than most	Has very agreeable working relationships with others		
Flexibility	Stubborn non-conformist	Slow to accept new ideas	Conforms without much pressure	Quick to accept new ideas	Easily persuaded, flaccid, unstable		

APPENDIX B

What is Creativity in Industrial Arts?

WHAT IS CREATIVITY IN INDUSTRIAL ARTS?[117]

When a student organizes his past experience in such a manner as to reach an unusual and useful solution to a perceived problem, he has formulated a creative idea. When the idea is expressed in an observable, overt form, he has developed a creative product. A student's creative ability is evidenced by (a) the relative degree of unusualness and usefulness of each of his products, and (b) the total number of his creative products.

The following material elaborates upon this general definition and provides guidelines for identifying and rating the creative abilities of industrial arts students.

I. Identifying and Rating a Creative Product

A. Product. An idea or combination of ideas expressed or manifested in any overt, observable form as a solution to a non-factual type problem is a product. Products may take many forms in the industrial arts, such as verbal (oral and written) communications, physical acts, two-dimensional representations, and three-dimensional objects.

B. Unusualness. To be creative a product must possess some degree of unusualness. The quality of unusualness may, theoretically, be measured in terms of probability of occurrence; the less the probability of its occurrence, the more unusual the product. The specific probability of occurrence of a particular student's product must be based on the actual or anticipated varieties of products of a peer group having similar experiential background. Thus, to rate the degree of unusualness of a student's product, it is theoretically necessary (a) to be familiar with the frequency of occurrence of varieties of peer products, (b) to select some probability level to represent the norm for "common" products, and (c) to possess means for translating probability deviations from the norm into ratings of unusualness.

C. Usefulness. While some degree of unusualness is a necessary requirement for creative products, it is not a sufficient condition. To be creative, an industrial arts student's product must also satisfy the minimal principal requirements of the problem situation; to some degree it must "work" or be potentially "workable." Completely ineffective, irrelevant solutions to teacher-imposed or student-initiated problems are not creative.

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[117] J. Moss and D. Bjorkquist, "What is Creativity in Industrial Arts?" The Journal of Industrial Arts Education, 24 (January-February, 1965), 24-27.

Like the quality of unusualness, usefulness is also relative. It is theoretically possible to establish a scale of product usefulness ranging from complete inadequacy to fulfill any of the requirements of the problem situation to products which far exceed the safety, economic, aesthetic, functional and other requisites of an acceptable solution. For example, one point on such a scale might represent the value of the commonly advocated classroom/laboratory practice or the "typical" teacher solution. Care must be taken in evaluating each product to distinguish between the usefulness of the idea inherent in the product and the quality of the manipulative or verbal skill evidenced in expressing the idea as a product; it is the former characteristic that must be rated and not the latter. Identification of the problem, awareness of the actual or potential value of the product-solution, and familiarity with the usefulness of the standard solution are therefore prerequisite to rating the usefulness of a specific student product.

D. Combining Unusualness and Usefulness. When a product possesses some degree of both unusualness and usefulness it is creative. But because these two criterion qualities are considered variables, the degree of creativity among products will also vary. The extent of each product's departure from the typical and its value as a problem solution will, in combination, determine the degree of creativity of each product. Giving the two qualities equal weight, as the unusualness and/or usefulness of a product increases so does its rated creativity, similarly, as the product approaches the conventional and/or uselessness its rated creativity decreases. The following table illustrates one possible model for combining the two essential qualities to arrive at a final creativity rating for each product.

II. Classifying Creative Products

While the same thought processes might be universally employed to formulate creative ideas, it is entirely conceivable that the particular type of thought materials being manipulated will differentially influence the efficiency of the processes for various individuals. This could result in students' displaying relatively high creative ability with one type of content and relatively low creative ability with another. To provide for this possible phenomenon, creative products should be classified according to a system which reflects fundamental and potentially significant differences among the thought materials used in their production.

For the creative products of industrial arts students, the categories of behavioral, symbolic, and figural content* are proposed. Behavioral content is contained in products dealing

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*J. P. Guilford, "Three Faces of Intellect," American Psychologist, 14:469-479, 1959.

Table 1.

Combined Product Creativity Ratings for Given Ratings of Unusualness and Usefulness

(Usefulness Rating)

(Unusualness Rating)

If the same problem was solved by a group of one hundred typical seventh grade students, would you find----------		The solution does not satisfy the principal requirements of the problem.	The solution satisfies the principal requirements of the problem.	The solution is as good as the commonly advocated or "typical" teacher solution.	The solution is better than the commonly advocated or "typical" teacher solution.
		0	1	2	3
More than 10 similar products	0	0	0	0	0
Between 6-10 similar products	1	0	1	2	3
Between 1-5 similar products	2	0	2	4	6
Less than 1 similar product	3	0	3	6	9

primarily with individual and group relationships, such as pupil-teacher and pupil-pupil interactions in persuasive or instructional situations. Symbolic content is displayed in products which represent the aesthetic and other abstract qualities of real, tangible objects or processes, i.e., systems of measurement, dimensioning, coding and representation, and the artistic aspects of design. Products with figural content contain ideas for the manipulation of real, concrete, inanimate objects and processes; the mechanics of performing an operation, the combination or use of materials for functional purposes, and the sequence or kind of operations used in completing a project are illustrations of this type of content.

It should be emphasized that the system classifies the content of the idea manifest in the unusual aspect of the product, and not the particular form of the product itself. For example, oral suggestions are products; these may contain unusual ideas for securing better cooperation among students (behavioral), improving the aesthetic qualities of a design (symbolic), or for arranging machinery for a mass production project (figural). Similarly, a sketch might utilize conventional symbols in an unusual manner (symbolic), or depict a new device for mitering wood (figural).

In addition to the proposed categories of creativity based on type of content (behavioral, symbolic, figural), the possibility exists that the more specific materials (wood, metal, etc.) dealt with in various industrial arts classes might also influence the extent of each student's creative abilities. Until there is an opportunity to test such an hypothesis, care must be taken in assuming that ratings of creative abilities in one industrial arts course are equivalent to what they might be in other industrial arts courses.

Consequently, during initial attempts to rate creativity, industrial arts courses differing in content should be treated discretely, and within each course behavioral, symbolic, and figural creative abilities should be rated separately.

III. Assessing the Relative Creative Abilities of Students

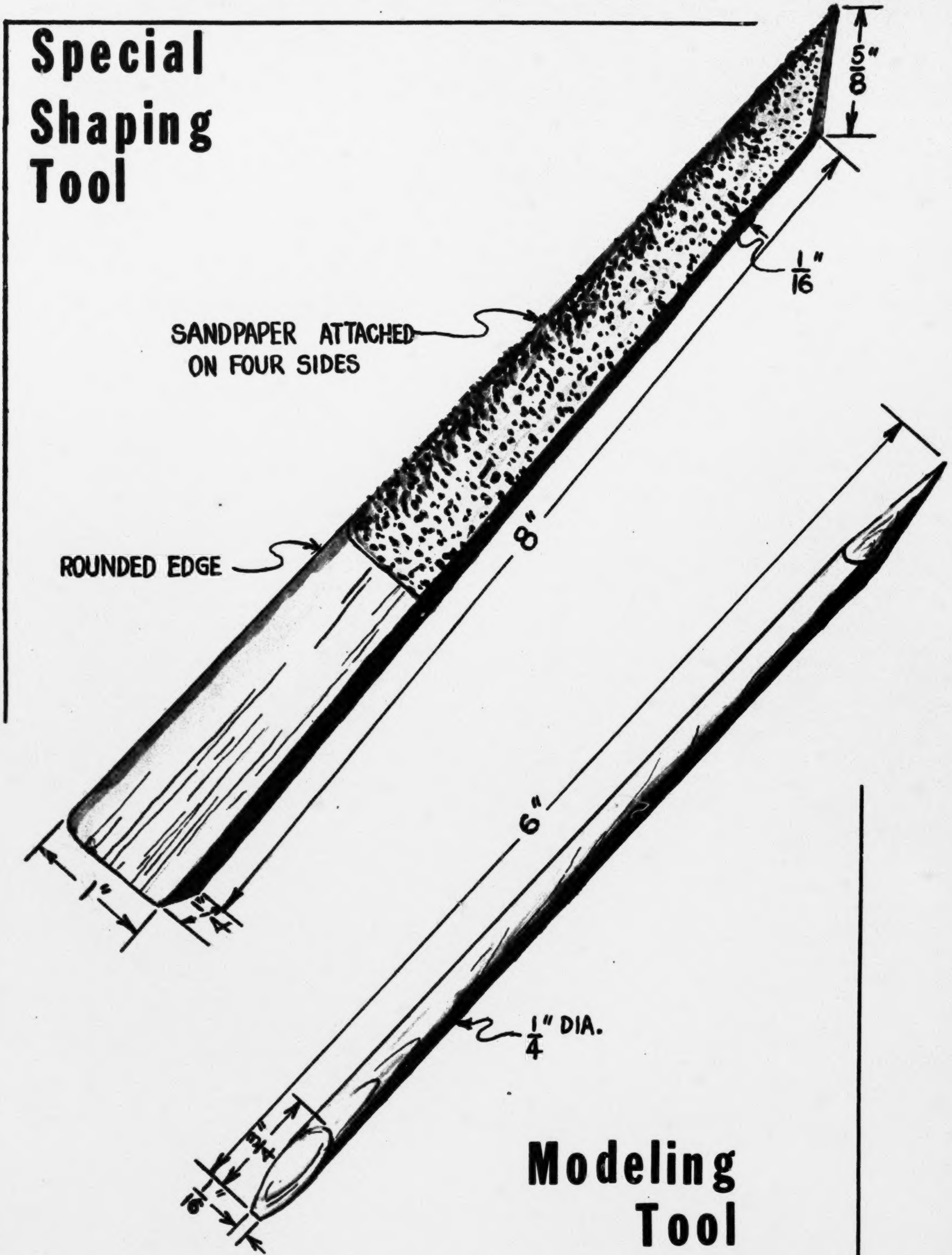
Within a given industrial arts course, each product of every student should be evaluated in terms of its unusualness. If a product is judged to be unusual to some degree (above a zero rating), its usefulness must then be estimated, and the two ratings entered on the student's record in the proper content category (behavioral, symbolic, or figural).

Under similar environmental conditions, the higher the ratings for each creative product the greater the number of creative products within each content category, the more creative the student is with content of that nature. To assess the relative creative abilities of students, it is possible to compare their creative production, over a given length of time, in each of the content categories. A relative measure of total "creativity" may be obtained by comparing students' cumulative creative productivity in all content categories.

APPENDIX C

Special Tools Used for Shaping Styrofoam in Test Approach B

Special Shaping Tool



Modeling Tool

APPENDIX D

Instrument for Evaluating Behavioral Creativity

WHAT WOULD YOU DO?

Name ____________________ Teacher ____________________ Date ________

School ________________________

Instructions: On the following pages are six situations which might occur in your industrial arts shop. You are to respond by describing what you feel would be effective ways to handle the problems which are described. There are no correct or incorrect solutions to these problems. There may be several possible solutions, but use your imagination to think of the one best way to handle the situation. You are urged to devise a practical way of solving each of these problems, a way which has never been thought of before. Write down only the best solution for each problem. Work as rapidly as you can without hurrying. Be as brief as possible in your explanations.

1. You are making a letter opener which you designed yourself. After seeing your design, two other boys decide to make identical projects. This disturbs you because you would like to take the credit for thinking of this idea when projects are displayed at open house. What would you do?

2. As a clean up assignment, it is your job to check that students put tools away. One boy always leaves his tools on the work bench. You are becoming tired of telling him to take care of his own tools and your teacher is so busy at clean up time that you don't wish to bother him with your problem. How could you handle this situation yourself?

3. Your class has been given the assignment of making a wall shelf. Because this same type of shelf is being made by six people in the class, it is difficult to distinguish your shelf parts from those of other students. There are no lockers in the shop so all project parts are stored on an open shelf. The next day you discover that the pieces which you cut out and sanded are gone and in their place are similar pieces which are very crudely done. You strongly suspect that another boy has traded his poorly done work for your nicely done shelf parts but you can't prove this. How would you handle this situation?

4. A classmate who is a good friend of yours depends on you much of the time to help him with his projects in the shop. You like to help him but you also know that if you assist him too much, he will not be learning to use tools properly himself. You also feel that if you refuse to help him any longer, he may be offended and you may lose his friendship. What would you do?

5. After waiting for some time to use a machine in the shop, another boy asks if he can use the machine first because his job will take only a few minutes. After graciously letting him go ahead of you, he finds that the job takes longer than anticipated and he continues to use it for twenty minutes. How would you handle the situation?

6. Your job at clean up time is to sweep the floor. One boy always works just a few minutes after the teacher calls clean up. As a result he always sweeps the shavings off his bench after you have already swept up. Therefore you must always make a special trip to sweep up his shavings. Repeatedly asking the boy to clean up on time hasn't helped. What would you do?

APPENDIX E

The Minnesota Tests of Creative Thinking

Abbr. Form VII

ABBREVIATED FORM VII

MINNESOTA TESTS OF CREATIVE THINKING

Name____________________________________Date__________________

Age____Sex____Grade or classification______________________________

School____________________________City_______________________

What kind of work would you like to do when you complete your education?

____

The four tasks in this booklet give you a chance to use your imagination to think up ideas. In two of these tasks you will be asked to put your ideas into words. In the other two, you will be asked to put your ideas into drawings, sketches, or figures. We want you to think of as many ideas as you can. Try to think of unusual, interesting, and exciting ideas -- somethink no one else in your class will think of.

You will be timed on each of these four tasks, so make good use of your time. Work as fast as you can without rushing. If you run out of ideas before the time is called, wait until instructions are given before going on to the next task.

Do not pay any attention to the rest of this page, but do not turn to the next page until told to do so.

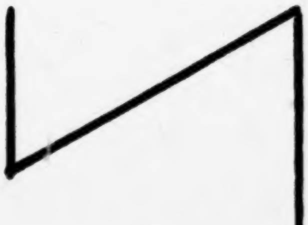
****

Scoring Category	Task 1	Task 2	TOTAL VERBAL	Task 3	Task 4	TOTAL NON-V	GRAND TOTAL
Fluency							
Flexibility							
Originality							
Elaboration							

Bureau of Educational Research
University of Minnesota
August 1962

TASK 1: FIGURE COMPLETION

By adding lines to the figures on this and the next page, you can sketch some interesting objects or pictures. Again, try to think of some picture or object that no one else will think of. Try to make it tell as complete and as interesting a story as you can by adding to and building up your first idea. Make up a title for each of your drawings and write at the bottom of each block next to the number of the figure.



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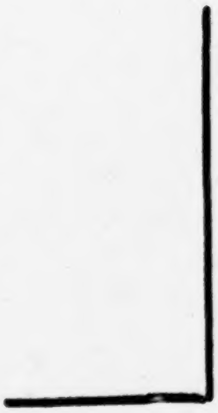

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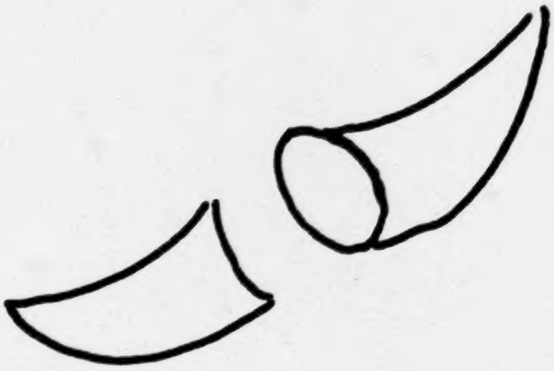

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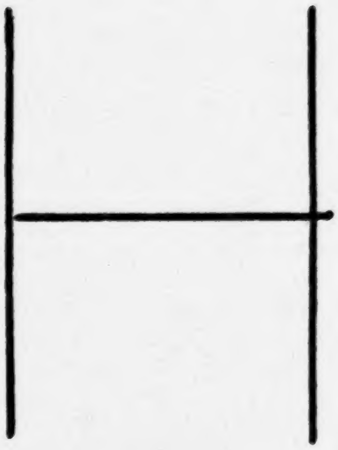

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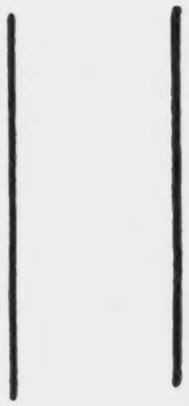

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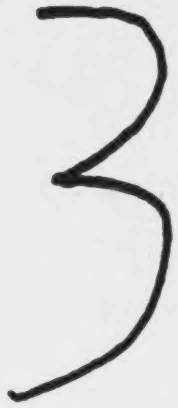

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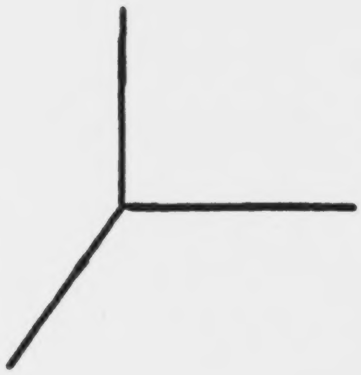

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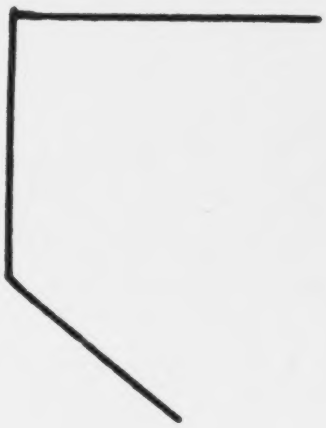

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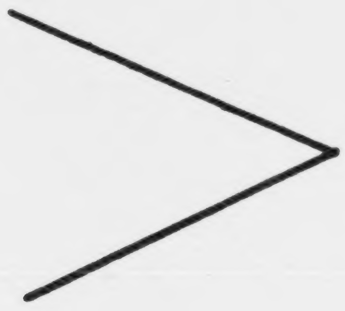
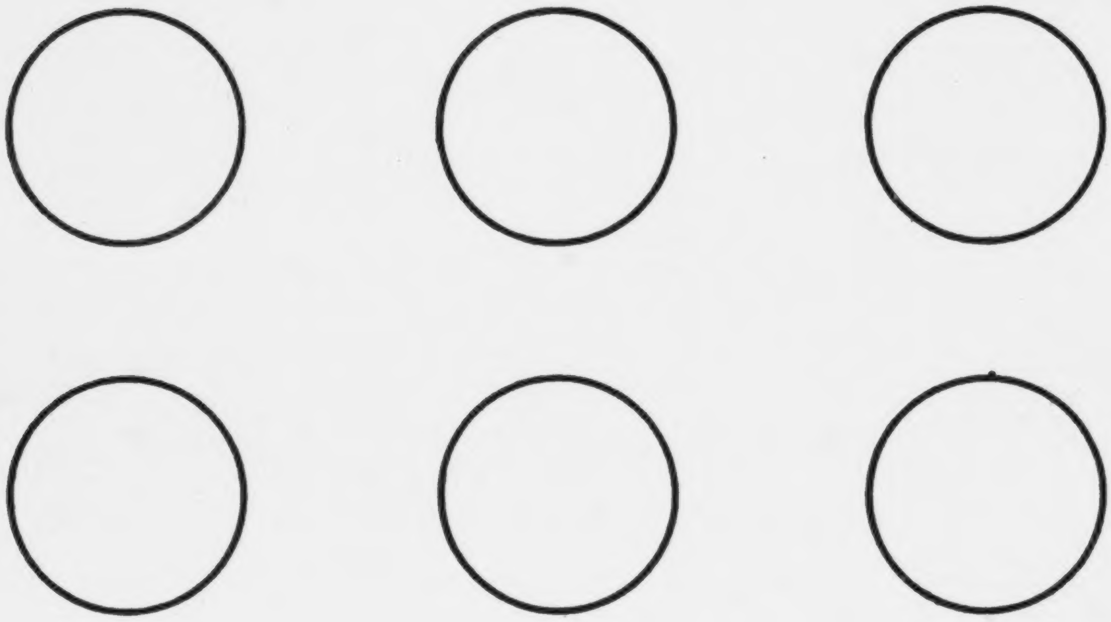


10.

TASK 2: CIRCLES

In ten minutes see how many objects or pictures you can make from the circles below and on the next page. The circles should be the main part of whatever you make. With pencil or crayon add lines to the circles to complete your picture. You can place marks inside the circles, outside the circles, or both inside and outside the circles -- wherever you want to in order to make your picture. Try to think of things that no one else will think of. Make as many different pictures or objects as you can and put as many ideas as you can in each one. Make them tell as complete and as interesting a story as you can. Add names or titles below the objects.



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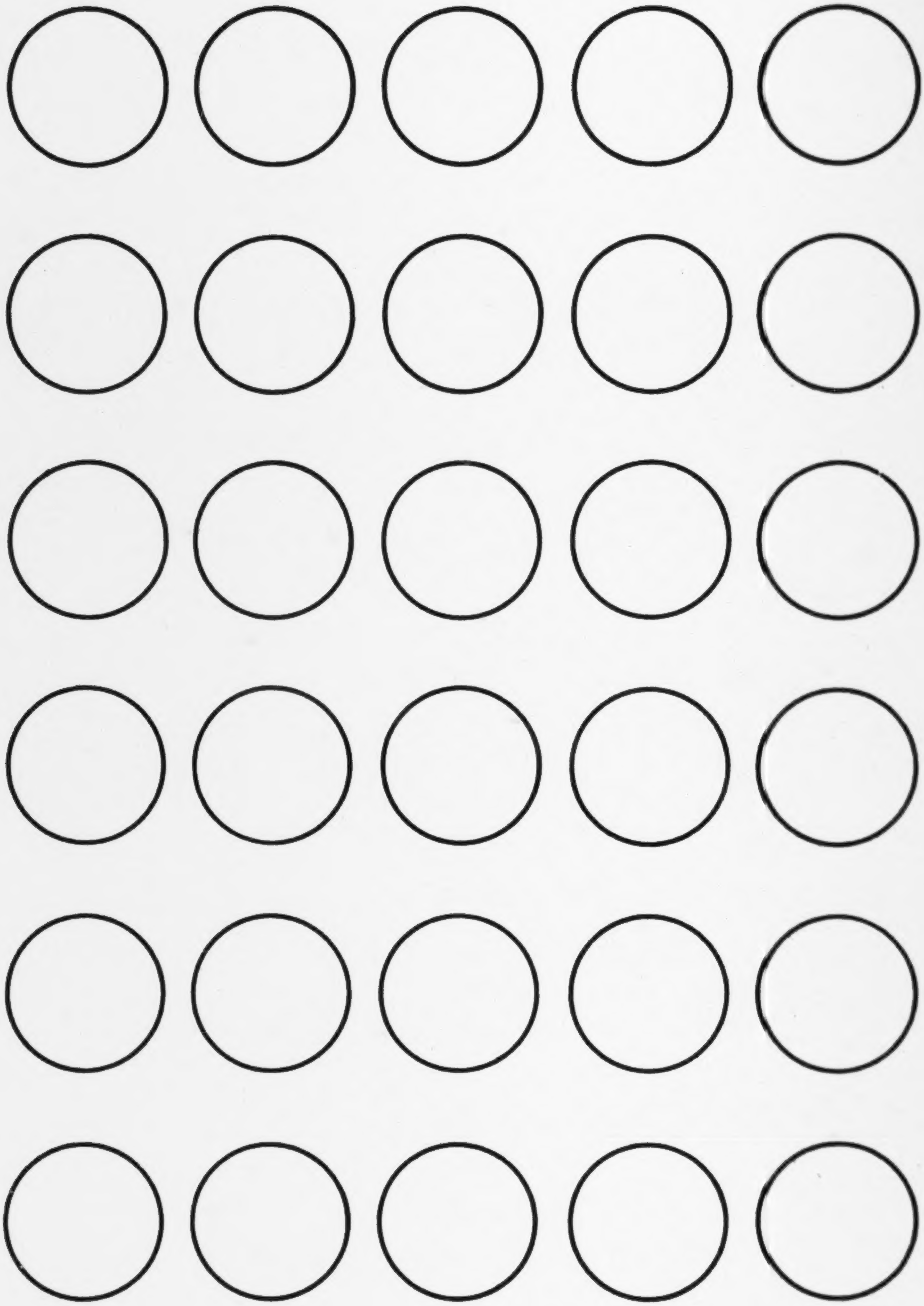
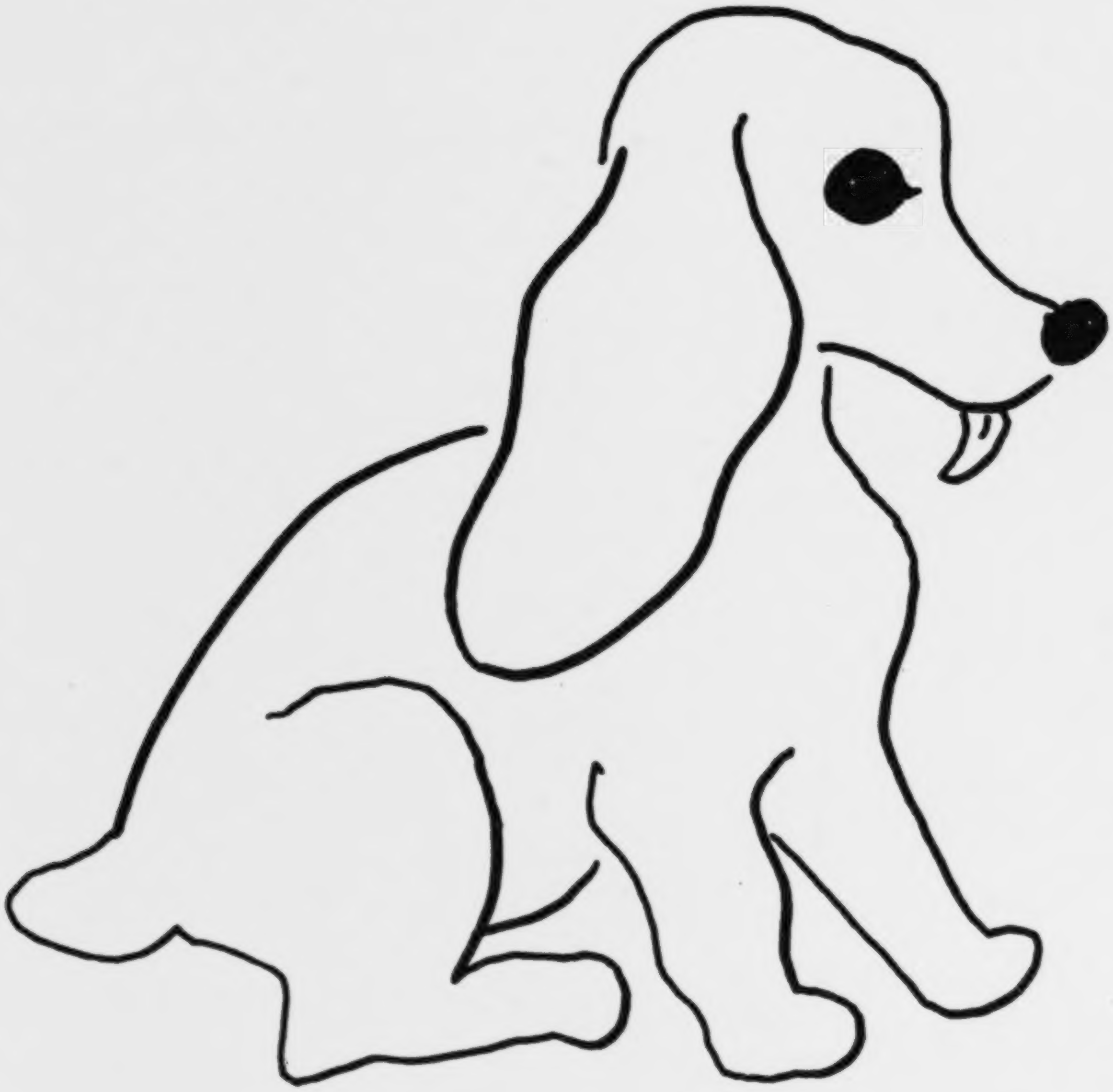


TASK 3: PRODUCT IMPROVEMENT

At the bottom of this page is a sketch of a stuffed toy dog of the kind you can buy in most dime stores for a half dollar to a dollar. It is about six inches long and weighs about three ounces. In the spaces on this page and the next one, list the cleverest, most interesting and unusual ways you can think of for changing this toy dog so that children will have more fun playing with it. Do not worry about how much the change would cost. Think only about what would make it more fun to play with as a toy.



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TASK 4: UNUSUAL USES (Tin Cans)

Most people throw their empty tin cans away, but they have thousands of interesting and unusual uses. In the spaces below and on the next page, list as many of these interesting and unusual uses as you can think of. Do not limit yourself to any one size of can. You may use as many cans as you like. Do not limit yourself to the uses you have seen or heard about; think about as many possible new uses as you can.

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